A GUIDE TO ORTHOPAEDICS

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PREFACE

Orthopaedics has been defined as the art of restoring and maintaining the functions of the locomotor system. It differs from other specialties in that it requires team work from others besides the specialist – medical practitioners, school and public health doctors, physiotherapists, chiropodists, almoners, health visitors and many others. It is thus not a specialist's specialty – indeed many cases never reach the specialist. If the orthopaedic services are to be efficient all those concerned must understand the subject, although they do not need to have an extensive and detailed knowledge of it. This is difficult for them to obtain, since textbooks must of necessity be exhaustive, and the smaller they are the more are they packed with detail.

This book is an attempt to help the non-specialist to understand the orthopaedic 'wood' as a whole without confusing the issues with too much detail about the individual 'trees'. Individual conditions are only considered where they illustrate the application of general principles, or when their treatment must be mainly in the hands of the non-specialist. For the same reason conditions whose treatment must be carried out almost entirely in orthopaedic departments are only considered very briefly or not mentioned at all.

Orthopaedics is usually regarded as being a difficult subject, perhaps because it is more of an art than a science. It is not possible to lay down hard and fast rules, for each case must be considered individually, taking into consideration not only the disability itself but also all the relevant personal factors, such as the age, occupation and mental outlook of the patient. This book is no more than the expression of a personal approach to the problems involved. As such it is wide open to criticism both as to its content and the opinions expressed. The most that I can hope is that it may make some of the problems seem a little less difficult to those who perforce are responsible in one way or another for the care of orthopaedic cases.

T. T. STAMM

CHAPTER I

POSTURE AND ITS MAINTENANCE
POSTURAL AND OTHER ACQUIRED DEFORMITIES

DEFORMITIES, ACQUIRED

Posture and Postural Defects

The position adopted by the various joints of the body at any given moment, and hence the posture of the body as a whole, is dependent upon the relative tone of the skeletal muscles concerned. In normal posture the joints of the trunk and the lower limbs are held in a position of balance so that the weight is transmitted directly from bone to bone in the line of gravity. Such a posture requires the minimum effort on the part of the muscles for its maintenance, and since no joints are held in an extreme position, there is no strain on any ligamentous tissues. Ligamentous tissues thus play no direct part in the maintenance of normal posture. It is essential for an understanding of those ailments which are primarily due to mechanical stress to realize that the primary function of ligamentous tissues is to prevent excessive movements. If they are subjected to continuous strain they soon voice their protests in the form of pain, and if the strain continues a reflex inflammatory reaction develops. The pain which soon develops at the back of the knee joints if one rests one's feet on the opposite seat of a railway carriage is a classic example of this reaction; and it is the explanation of the syndrome recognized by the clinical term 'chronic strain'.

Defective posture may be defined as any attitude in which any of the joints are off balance relative to the force of gravity. If this occurs a much greater effort is required by the muscles to retain the position and this soon leads to muscle fatigue. The muscles concerned may then give up the attempt and relax. The strain of weight bearing will then fall on the ligaments. The afferent stimuli which arise in ligamentous tissues when they are subjected to a stretching force are at first no more than a request to the central nervous system to increase the tone of the protecting muscles. It is only when the stretching force is severe or continuous that it reaches the threshold of pain and becomes an urgent SOS.

Owing to the variations in shape and build of different individuals it is not possible to define correct posture mathematically. It can best be defined as that attitude which in the particular individual makes the least demands on the muscles for its maintenance. Posture must not, however, be regarded as a static function, for movements of any part of the body demand continuous alterations of posture in order to maintain balance.

The maintenance of posture is a function of the central nervous system. Early in life an habitual pattern of posture is developed. The parts of the central nervous system concerned, which for convenience are called the postural centres, recognize this pattern through the afferent impulses they receive from the joints, muscles and ligaments, and also from the skin and special sense organs. After any movements or change of position they will always try to restore the body to its habitual posture.

These and other similar centres are also responsible for carrying out movements or series of movements and they learn to carry out most of our habitual activities automatically. Thus the conscious part of the brain only needs to issue a general directive and is relieved of much tedious effort. Since these lower centres work by habit, once any particular series of movements has been learnt it will always be carried out in precisely the same way, unless the conscious part of the brain interferes. Thus we develop characteristic ways of doing things such as walking, tying up shoe laces or playing golf. Hence also the importance of learning good habits to begin with, for once formed they are very difficult to alter.

It should also be noted that movements carried out automatically are performed with much greater economy of muscle effort than those performed under direct conscious control. For example, if one consciously dorsiflexes one's foot fifty times a definite feeling of fatigue will be produced in the anterior tibial muscles. Yet this action is carried out a thousand times when walking a mile without producing any such feeling. This economy of muscle usage which occurs when performing habitual actions has an important bearing on rehabilitation measures.

Mechanics of Good Posture

The posture of the body can only properly be considered as a whole, for the attitude of each segment is influenced by that of adjoining parts. In most individuals a correct balance is achieved when

the line of the centre of gravity passes through the mastoid process, the middle of the shoulder and hip joints, the patella and head of the talus. It is dependent essentially on the posture of the head, the pelvis and the feet.

Correct carriage of the head is the position adopted when trying to touch the ceiling with the top of the skull. In defective posture the forward convexity of the cervical spine tends to be increased, allowing the head to sink downwards and forwards. This will cause a secondary depression of the rib cage, lowering of the diaphragm and consequent protuberance of the abdomen.

The degree of forward inclination of the pelvis is determined by the relative tone of the muscles which act upon it, the most important being the gluteus maximus whose action is to tilt the pelvis backwards. It should be noted that it is also a lateral rotator of the leg. In the standing position lateral rotation of the leg, acting through the talus, causes inversion of the foot bringing up the long arch into its active and balanced posture. Thus by increasing the tone of the gluteal muscles the whole posture of the body can be modified.

AETIOLOGY OF POSTURAL DEFECTS

The causes of defective posture in the individual case are often difficult to assess, but three main factors should always be considered:

1. *Growth*

The child is constantly having to adapt itself to changing conditions, first in learning to adopt the upright posture and its powers of locomotion, and thereafter the changes resulting from growth itself, especially as muscles and bones do not always grow at the same rate. It is not surprising, therefore, that postural habits which are being continuously modified are not always correct.

2. *Ill Health*

Resisting the force of gravity requires a constant co-ordinated effort on the part of the nervous system and the skeletal muscles. When the body as a whole is in a debilitated condition the locomotor system tends to suffer most from 'economy cuts' in the organism's expenditure of energy. The general posture of the body then tends to sag into positions where the strain can be taken by the ligamentous tissues rather than by the tone of the muscles. The individual then stands with the head sunk downwards and forwards, the chest in the

position of expiration, the abdomen prominent and the legs rotated medially, giving an appearance of knock knees and valgus ankles.

3. *Stress*

Psychological factors may have a very marked effect upon posture. Three main types may be recognized:

(*a*) Neurasthenia. The posture adopted in this state is the same as that resulting from physical weakness as described above. In children it is especially noticeable amongst the scholarship class. It is as if the nervous system has not enough energy to run both their mental activities and the locomotor system – like a car whose starter will not work if the lights have been left on.

(*b*) Anxiety states. The typical posture is again similar to the above but the muscles are tense rather than lax.

(*c*) Inferiority complex, or the state of fear. The posture then can best be described as cringing, with the head sunk downwards and forwards and the whole of the spine in a forward flexed position; which is in turn compensated for by flexion of the hips and knees.

CORRECTION OF POSTURAL DEFECTS

Since the maintenance of posture is a function of the central nervous system, and since its control over posture is determined by habit, it is clear that the correction of postural defects can only be achieved by inducing the 'postural centres' to adopt new habits of posture. Moreover, since their appreciation of the position of the various parts of the body is dependent upon the sensory impulses they receive, it is also clear that any re-education must be conducted through the sensory mechanism. In other words they must be induced to accept a new and different sensory pattern as being the one to regard as normal.

The first step in treatment must therefore be to make the individual adopt by conscious effort the posture that is considered to be correct. This will at first feel strange and unnatural, until the 'feel' of the corrected posture has been learnt. It is always helpful if the patient is able to see himself in a mirror so as to be able to correlate what he sees with what he feels.

The next stage is to undertake some activity, such as walking, while maintaining this posture, then adding complications such as holding a glass full of water while walking along a chalked line. Thus

the postural centres are gradually induced to 'take over' the new posture until they accept it as normal and it is adopted automatically. Since all the sensory organs are concerned in providing the postural centres with the complete 'postural picture' they should all be brought into play. Hence the value of dancing in time to music. Ballet technique is also most valuable, for correct posture of the trunk has to be maintained while carrying out rhythmical movements with the legs.

The correction of postural defects is thus a matter of re-educating the activities of the central nervous system. It can *not* be achieved by giving exercises to 'strengthen weak muscles'.

THE SPINE

Antero-posterior Curves

1. *Postural*

The posture of the spine as a whole is mainly dependent upon the degree of forward inclination of the pelvis. An increase in its forward angulation produces a lumbar lordosis with prominence of the abdomen. This is compensated for either by a corresponding thoracic kyphosis, or by a backward leaning attitude of the whole of the spine above – 'sway back'. An unduly vertical sacrum produces a lessening of the lumbar lordosis with a flat back, sometimes associated with a hunching of the shoulder region – 'round back' (Fig. 1).

During pregnancy posture has to be modified owing to the increasing size and weight of the uterus. The normal adaptation consists in a backward rotation of the pelvis with flattening of the lumbar spine. In multipari with lax abdominal walls the enlarging uterus tends to sag forwards once it has emerged from the pelvis. In doing so it, as it were, drags the lumbar spine forwards with it, producing a lumbar lordosis accompanied by an exaggerated forward inclination of the pelvis. This faulty adaptation is likely to produce symptoms of low back strain.

A similar change in posture occurs in obesity. In both cases external support may be necessary in the form of a maternity corset, though in the latter case it is not described as such.

Thus in most cases where the posture of the spine is defective and unbalanced, it is the habitual inclination of the pelvis that should receive special attention.

2. *Structural*

An acquired kyphosis of structural origin occurs in one of two forms. If it is due to localized injury or disease, such as a crush fracture or tuberculosis, the kyphus will be sharply angulated with

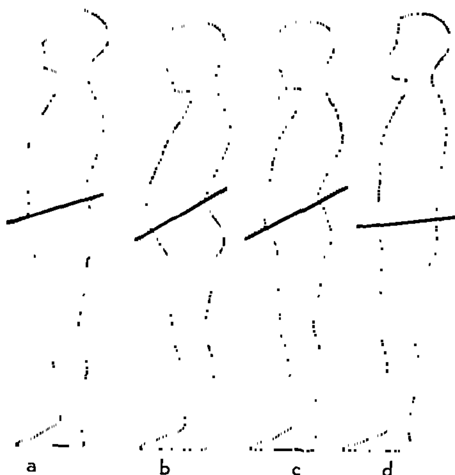


FIG. 1

TYPES OF POSTURE

(a) Normal posture
(b) *Lumbar lordosis*
(c) Sway back.
(d) Flat back.

compensatory curves in the opposite direction above and below, so that it has concave sides (Fig. 2c). In other cases where a number of vertebrae are affected the curve will be less angular, and the spine will be flat above and below, the so-called 'dish cover' back (*Fig. 2b*). This

type of kyphosis is most commonly due to the results of juvenile osteochondritis but it also occurs in the elderly as a result of partial collapse of several vertebrae in cases of senile osteoporosis.

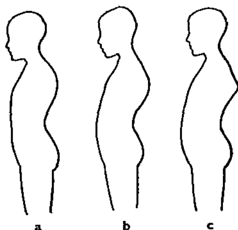


FIG. 2
TYPES OF KYPHOSIS

SCOLIOSIS OR LATERAL CURVATURE

1. *Postural*

A postural lateral curvature of the spine is nearly always compensatory to some other deformity elsewhere: for example, shortness of one leg, which imposes a tilt on the pelvis and a compensatory curve in the spine above.

The characteristic features of such a curve are that it is easily correctable, it is not progressive, and it disappears when the primary cause is removed. In the case of a short leg the curve is only present when the individual is standing.

The only cases in which the curve may to some extent become fixed are those where it has to operate all the time, even during rest. For example, a fixed adduction deformity of the hip will impose a constant tilt on the pelvis with a compensatory lateral curvature in the lumbar spine. As this attitude has to be adopted even during rest to prevent the legs being crossed, it will eventually become partly fixed, but even so it will never progress beyond the degree necessary to compensate for the tilt of the pelvis.

2. *Structural*

This may be due to congenital anomalies such as wedge vertebrae (see torticollis), to destructive disease, for example tuberculosis, or the deformity may be imposed on the spine by outside factors. In

the latter case it is usually in the thoracic region and is due to such conditions as a fibrotic lung, or a thoracoplasty.

3. *Paralytic*

Partial paralysis of the spinal muscles which are unequally affected on the two sides is the most potent cause of a progressive scoliosis. Poliomyelitis is the commonest cause. In severe cases the combination of body weight with the unequal pull of the remaining muscles produces a most extreme and rapidly progressive deformity that defies all attempts to control it.

4. *Idiopathic*

In this group are included those cases which have the characteristics of a paralytic curve without there being any detectable weakness of the spinal muscles. They occur most commonly in young adolescents and are progressive until growth ceases. Girls are most commonly affected. The lateral curvature is nearly always associated with rotation of the vertebral bodies towards the convex side, and of the spinous processes towards the concavity. The primary curve is usually in the thoracic region with secondary curves above and below. The ribs follow the rotation of the vertebrae so that the rib cage becomes prominent behind on the convex side, and on the concave side in front.

Treatment. Treatment is rarely indicated for curvature of structural origin. In postural and compensatory curvature it is necessary first to define the primary cause, whether this be mechanical or physiological. When the curve is compensatory to some deformity elsewhere the treatment is that of the primary deformity. Once the cause has been defined and dealt with, postural re-education should be carried out on the lines already discussed.

Paralytic and idiopathic scoliosis presents a problem that has so far defied all attempts to effect a cure. In the majority of cases the most that can be hoped for is to limit the extent to which the deformity progresses, and to ensure that the spine as a whole is 'compensated' — that is to say that the shoulders are in a horizontal plane and lie squarely above the hips, so that the posture of the body is evenly balanced.

If the curvature is progressing rapidly a period of recumbency may be indicated. During such a period attempts at partial correction may be undertaken.

In paralytic cases a spine-grafting procedure is sometimes carried out when the maximum amount of correction has been achieved. The results are, however, rather disappointing as the deformity may progress in spite of a successful grafting operation.

TORTICOLLIS OR WRY NECK

This is usually the result of damage to the sternomastoid muscle during birth. The damaged muscle fibres are eventually replaced by fibrous tissue. As the child's neck grows and the fibrous tissue contracts, the mastoid process on the affected side is drawn downwards and forwards, giving the characteristic tilt to the head. The deformity does not usually become noticeable until the age of 3 or 4 years, but unless it is corrected at a fairly early age a secondary asymmetry of the face will develop, and this will spoil the eventual cosmetic result, though some degree of facial asymmetry may persist even in spite of early treatment.

There are a number of other conditions which produce deformity of the neck. The most important are congenital wedge vertebrae, destructive disease such as tuberculosis, contractures following burns or infections of the cervical glands, ocular defects, and spasmodic torticollis, which is a 'tic' of nervous origin.

DEFORMITIES IN THE LEGS

Apart from deformities of the hips and feet which are dealt with elsewhere, there are three common deformities of the legs which occur in children and require special consideration.

1. GENU VALGUM OR KNOCK KNEES

This deformity may occur as a result of deformity or disease which affects the epiphyses of the femur or tibia at the knee joint. In the great majority of cases, however, there is no obvious cause, especially now that rickets has become a rare condition. It is usually first noticed when the child begins to walk and may increase in severity up to the age of 4 or 5 years. After that age the deformity gradually disappears spontaneously in nearly all cases.

Advice is often sought not for the knock knees but because the child walks 'pigeon-toed'. This inverted attitude of the feet appears to be a natural attempt to correct the line of weight bearing, and children who do this grow out of their knock knees more rapidly. This gives the clue to treatment which is to encourage a slightly

the latter case it is usually in the thoracic region and is due to such conditions as a fibrotic lung, or a thoracoplasty.

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If the curvature is progressing rapidly a period of recumbency may be indicated. During such a period attempts at partial correction may be undertaken.

(ii) *At the upper end*

In these cases the tibia is both bowed and twisted laterally in its upper third. This gives rise to a most peculiar appearance, for if the knees face forwards the feet make an angle of as much as 90° with each other, and the child looks knock kneed. If, however, the feet are placed parallel the patellae face inwards towards each other and the child looks bow legged (Fig. 3).

Unlike the deformities already mentioned this type tends to get worse rather than better as the child grows. It has recently been suggested that the lateral torsion of the tibia is secondary to a congenital lack of lateral rotation at the hip. This is part of the congenital anomalies that in its more severe forms result in congenital dislocation of the hip. It is important that it should be recognized as it often requires surgical correction, which will come as a shock to the parents if they have previously been told that, like the other deformities mentioned above, it is of no serious significance.

inverted attitude of the feet by providing a ⅛-inch inside wedge to the heels of the shoes – and what is more important, to reassure the parents. Splints and knock-knee irons are horrors of a past age. For the very occasional case where the deformity persists after the age of about 10 years, correction by a supra condylar osteotomy is far preferable to years of splinting.

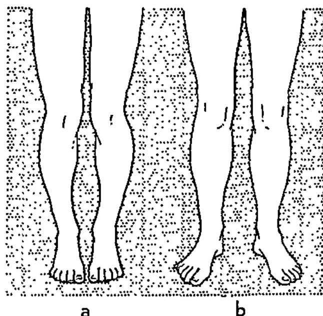


FIG 3

LATERAL ROTATION OF TIBIAE

(a) When feet are parallel the knees face towards one another, giving a bow-legged appearance.

(b) If the knees face forwards the feet have to be angled outwards, producing a knock-kneed appearance

2. GENU VARUM OR BOW LEGS

A bow-legged appearance is usually due to deformity of the tibiae and it occurs in two forms:

(i) *At the lower end*

This is so common in infants as to be almost normal. As well as being bowed the tibia has an inward twist at its lower end so that the feet point somewhat medially. It usually disappears soon after the child begins to walk and is never of any serious significance.

minimize strain on the back is often helpful. It should be explained to him that the spine is most vulnerable to strain when in a forward flexed position – as when bending over a sink. Such activities should be split up as far as possible. Lifting should be done by bending the knees rather than the spine. Other measures which may be indicated are a manipulation (p. 104) or a corset type of support (p. 112).

THE DISC SYNDROME (LUMBAR)

The intervertebral discs consist essentially of a soft pulpy core, the nucleus pulposus, retained by a surrounding layer of tough fibrous tissue forming a capsule. Body weight and forward flexion compress the discs, the tendency for them to bulge being restricted by the enclosing capsule. A normal intervertebral disc is so strong that it is impossible to damage it by any form of violence (except in the cervical region), for the bones will always give way first. This is an important point to realize, for it means that the occurrence of any mechanical derangement of an intervertebral disc presupposes that its tissues must have been in a softened or degenerated state at the time, and that such derangements are pathological rather than traumatic in origin. This is borne out by the fact that the strain that produces a disc prolapse is usually quite trivial in nature – such as bending down to pick up something from the floor.

It is recognized that the occurrence of degenerative changes in the tissues of the intervertebral discs is part of the normal ageing process, and that starting in early adult life they lead eventually to the gradual absorption of the nucleus pulposus, with narrowing of the intervertebral spaces. This is the main reason why one loses stature with advancing years. It is reasonable to suppose that before the final stage of absorption of the nucleus is reached there might well be a period when the degenerative processes had rendered the joints susceptible to trauma. So it is that lumbago and sciatica are *traditionally* the prerogatives of middle age. During recent years, however, there has been an increasing tendency for these symptoms to appear in young adults. Whereas a generation ago back strains in young adults would usually clear up in a week or two, now the symptoms frequently persist, and the signs of a disc prolapse develop. In such cases there must be some additional factor which has caused sufficient weakening of the tissues to permit a mechanical derangement to occur. This is borne out by the soft pulpy condition of the disc seen at operation in young people, and by the fact that often a number of joints are

CHAPTER II

BACKACHE AND THE DISC SYNDROME

Low back pain is by far the commonest symptom to be encountered in any Orthopaedic Clinic. Its aetiology and diagnosis presents a complex problem, for there are innumerable causes for such pain. Fortunately, however, in the great majority of cases the cause can be traced to the effects of mechanical strain, and to the secondary results of such strain upon the tissues.

Mechanical Strain

Pain of mechanical origin is nearly always the result of a compression or stretching force being applied to the soft tissues. As stated in Chapter I, in normal posture the weight is transmitted directly from bone to bone, the joints being held in a balanced position so that there is no tension on any ligamentous structures.

Man's upright posture has imposed an acute bend on the lower lumbar spine so that the joints are held off balance, the weight being ... nt surfaces. This applies ... moreover at the junction ... which is always the site of maximum stress. It is not surprising, therefore, that this joint should be so frequently the cause of trouble. Indeed it is more surprising that anyone can escape having pain in this region.

Low back pain is therefore due primarily to the stress of weight bearing on this mechanically weak section of the spine. The symptoms consist in an aching pain, which is brought on by activity, but which persists for some time afterwards and is associated with a feeling of stiffness. This is due to the reflex inflammatory reaction which

should be corrected, but this entails such a long period of individual attention from an expert physiotherapist that it is rarely an economic possibility. Advice on rearranging the patient's activities to

The disappearance of pain in the back is of course due to relief of tension in the joint when the capsule gives way. With a complete extrusion cure is only possible by operation, or possibly in the end by slow absorption of the extruded material.

Thus the disc syndrome appears in four distinct stages – strain, internal derangement, external derangement or prolapse, and occasionally extrusion. Each may be associated with a variable amount of inflammatory reaction. The variations in the clinical picture are therefore considerable. In some the degenerative or inflammatory factor may predominate (especially in the young) while in others a prolapse may occur with little or no warning. However, by analysing the history of the case even more than by examination of the patient, it is usually possible to assess the relative importance of the various factors that may be concerned, so that one is able to visualize what has been happening to the affected joints, and what the present state of affairs is likely to be.

PHYSICAL SIGNS

1. There will be tenderness over the interspinous ligament of the joint or joints affected. This fortunate provision of nature compensates to some extent for the fact that we cannot examine these joints directly.

2. Limitation of movement will be primarily in the plane of flexion and extension. If the patient can flex the spine normally no mechanical derangement of an intervertebral disc is present.

3. There may be a lateral tilt of the spine to one side, the so-called sciatic scoliosis. Movement to the opposite side will then be restricted, but rotation remains free.

4. Straight leg raising will be restricted on the affected side if any disc prolapse is present.

5. Physical signs indicating interference with nerve function, such as muscle wasting and numbness, will only be present if the nerve root is being subjected to actual pressure. Nerve irritation, or tension on the root causes pain only. Although the absence of signs of pressure does not necessarily mean that there is no prolapse, their presence is a very useful confirmation of this diagnosis.

Finally, the distribution of neurological signs or symptoms should correspond to the level of the local signs in the spine. In the great majority of cases it is the joints between L.5 and S.1 or L.4 and 5 that are affected.

affected. The cause of these pathological changes is unknown, but they may well have a metabolic or nutritional background.

There is one further predisposing factor that must be considered. Any joint which has been subjected to a strain or other injury becomes the seat of a reflex inflammatory reaction – producing swelling of the tissues and a synovial effusion. The intervertebral discs will exhibit the same reaction after a strain but there is so little room within the annular capsule that considerable tension is likely to develop – and this, apart from causing severe pain, will predispose to a prolapse if there is any associated weakness of the capsule.

Bearing these facts in mind it is possible to visualize the state of the joints from the history presented by the patient. To take a hypothetical case that passes through all the various possible stages: there may first be a history of low backache, coming on with activity and settling down after a few hours' rest. Then a sudden sharp pain when lifting a heavy object, or bending awkwardly. This pain may indicate no more than a sudden stretch of the joint capsule, but it may also be caused by displacement of the nucleus within its capsule so that it becomes eccentric and partially detached – an internal derangement as it were. Over the next few hours the pain steadily increases in intensity owing to reactionary swelling so that the slightest disturbance of the tense joint tissues causes severe pain. This is the commonest form of 'lumbago', though sometimes the inflammatory reaction is not due to trauma but to some 'rheumatic' affection.

After several of these episodes, with periods of backache in between, on some occasion an attack of 'lumbago' is associated with pain down the back of the leg. This means that as the result of the softening changes resulting from previous attacks some part of the capsule gives way sufficiently to allow part of the nucleus to bulge out from between the bones, producing pressure on the nerve root lying alongside. There is now, therefore, an external derangement or prolapse. This again may disappear spontaneously as the swelling of the tissues subsides, or it may be reduced by traction or manipulation.

Finally, on a further occasion the pain in the back suddenly disappears while the pain in the leg becomes worse and may be associated with more disturbance of sensation, and muscle wasting. What has happened this time is that the capsule has given way completely in one place and the nucleus or part of it has become extruded through the rent to lie free as a loose body in the extradural space.

The disappearance of pain in the back is of course due to relief of tension in the joint when the capsule gives way. With a complete extrusion cure is only possible by operation, or possibly in the end by slow absorption of the extruded material.

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3. There may be a lateral tilt of the spine to one side, the so-called sciatic scoliosis. Movement to the opposite side will then be restricted, but rotation remains free.

4. Straight leg raising will be restricted on the affected side if any disc prolapse is present.

5. Physical signs indicating interference with nerve function, such as muscle wasting and numbness, will only be present if the nerve root is being subjected to actual pressure. Nerve irritation, or tension on the root causes pain only. Although the absence of signs of pressure does not necessarily mean that there is no prolapse, their presence is a very useful confirmation of this diagnosis.

Finally, the distribution of neurological signs or symptoms should correspond to the level of the local signs in the spine. In the great majority of cases it is the joints between L.5 and S.1 or L.4 and 5 that are affected.

TREATMENT

The treatment of any disc derangement comprises two stages, first any displacement must be reduced, and then measures should be adopted to assist healing of the damaged joint tissues.

When deciding what line of treatment to adopt the following points should be borne in mind:

1. The derangement more often than not is no more than a displacement eccentrically of the nucleus or a part of it within the capsule or annulus of the joint. Reduction can therefore occur quite easily and spontaneously once the reactionary inflammation and muscle spasm have subsided.

2. The longer the displacement persists the more difficult does reduction become.

3. It is often possible to effect reduction by mechanical means such as traction or manipulation.

4. If the displacement has been present for a long time, or an actual extrusion has occurred, the latter being often the reason for the former, then relief can only be effected by operation.

5. If an unreduced prolapse is left too long a mass of fibrous adhesions may form binding all the adjacent structures together. Even operation is then unlikely to give complete relief.

Stage 1. *Reduction*

It is well recognized that the majority of cases will settle down rapidly with bed rest combined with the application of heat and gentle massage. This should always be given a trial first unless the pain is too severe. If there is no response within ten days further action should be taken, either by applying intermittent or continuous traction or by performing a manipulation. The choice will depend largely on the individual circumstances. If all these measures fail operation must be considered, but in practice this will only apply to about 5% of cases.

Stage 2. *Healing*

Once the pain has been relieved the patient imagines that he is cured. It is essential to explain that healing has still to take place, just as it would if he had broken a bone. The means adopted to promote healing consist first in providing a support – a plaster jacket is the most effective, followed after a month to six weeks by a surgical

corset; second, giving recumbent back exercises to keep the muscles in good trim so that they can eventually take over; finally, advise with regard to activities as for back strain.

Since a 'slipped disc' is merely an incident during the course of a degenerative or inflammatory condition, one should also treat the primary cause. One day perhaps biochemical research will enlighten our ignorance and enable us to do this. Until then we can only follow our own particular fancies, whether they be drugs, diet or vaccines.

Operative Measures

Surgery is undertaken first to remove the displaced tissues that are pressing on a nerve root, and second to restore strength and stability to the affected part of the spine.

The surgical removal of a disc prolapse is indicated primarily for those cases where conservative measures have been given a fair trial and have failed, or when repeated recurrence of symptoms occurs in spite of adequate care. It is also indicated when as a result of prolonged pain, the patient's morale is suffering. Pain in the back is second only to pain in the rectum in its power to induce mental upset and 'neurosis' and the relief of pain by effective surgery often results in a dramatic cure of psychological disturbances. One should beware of dismissing back pain as being of neurotic origin unless there are no abnormal physical signs.

The second type of operation entails the fixation of the affected joint or joints, usually by a bone graft. This is a tempting procedure since removal of a prolapse alone still leaves a damaged joint and does not necessarily ensure relief of all pain in the back. There are, however, three objections to this procedure:

1. It greatly prolongs the convalescence: from 2-3 weeks to 3-4 months, and it is attended by a quite definite risk of failure.
2. It throws more work on to the remaining joints. Unless they are normal the effect in the end may be merely to move the site of pain higher up. This applies especially to the younger patient.
3. In late cases the root pain may be due to the anchoring of the nerve root by fibrous adhesions resulting from a previous prolapse. The pain is then due to the root being pulled upon by movements of the spine above or the hip below. Fixing the affected joint can clearly do nothing to relieve the pain. This important consideration is often overlooked.

Spine grafting has, therefore, a very limited place in the treatment of these conditions. It is chiefly indicated for those cases where there is persistent pain in the back rather than in the leg, which has always arisen from one single joint, and where there is evidence of definite structural weakness, as in spondylolisthesis.

OTHER CAUSES OF PAIN IN THE BACK

1. Osteoarthritis of the Spine

With advancing years osteoarthritic changes are very liable to develop in any of the joints of the spine. Since the condition is in itself a painless process it may reach an advanced stage without producing any symptoms. Pain when present may be due to nipping of soft tissues between projecting osteophytes, to stretching of contracted capsules and fibrous adhesions, or to inflammatory episodes of a 'rheumatic' type. Since the emerging nerve roots lie in contact with both the intervertebral discs and the posterior joints they are liable to be irritated by friction, over projecting osteophytes, by tension resulting from fibrous adhesions, or by any inflammatory process that affects the joints themselves. In such cases there may be referred pain in the area of their distribution but physical signs indicating actual pressure on the nerve roots is rare.

Referred pain from localized osteoarthritis in the spine is productive of considerable confusion in diagnosis, for, according to the level of the lesion, symptoms suggestive of a variety of conditions may be imitated, from renal calculi and gall-stones to angina pectoris. This explains many of the cures obtained by lay manipulators, for if the symptoms are produced by fibrous adhesions anchoring the nerve root to the affected joint, a manipulation which succeeds in breaking down such adhesions may entirely relieve the symptoms. He will thus get the credit for having cured a case of, say, gall-stones, by his manipulation of the spine, when in fact the patient was suffering from osteoarthritis at the level of T.8-9.

Osteoarthritis of the spine may therefore produce a combination of local and referred pain that is superficially suggestive of a disc prolapse, and the differential diagnosis can be very difficult.

The main distinguishing features are:

1. That whereas in the case of a disc prolapse the loss of movement is chiefly in the range of flexion, in osteoarthritis all movements will be more or less equally, but not severely, affected.

2. The X-ray appearances. They usually show no abnormality or perhaps slight narrowing of the intervertebral space in the case of a disc prolapse. In osteoarthritis there is often gross narrowing of the joint with obvious osteophytic lipping of the margins of the joint.

3. There is referred pain in both, but rarely are there any signs of defective nerve function in osteoarthritis, except occasionally in the cervical region.

The treatment of osteoarthritis of the spine must be dependent upon an analysis of the cause of the symptoms in each case. If the pain is of a constant aching character, present even during rest, with guarding muscle spasm, indicating the presence of some inflammatory reaction, the indications are for rest, heat and analgesics. When pain is only brought on by activity it is most likely to be due primarily to stiffness of the joint resulting from fibrous adhesions or contracted joint capsules. Treatment should then be the opposite – namely manipulation, followed by active physiotherapy. If it should prove impossible to restore the affected joints to painless function, then a protective support is indicated. Very occasionally it may be justifiable to put the support inside in the form of a bone graft. This of course only applies in the case of a localized arthritic process such as that which may follow a crush fracture, and its indications are subject to the provisos already mentioned in the case of disc lesions.

2. Sacro-iliac Strain or Subluxation

Sacro-iliac pain is usually due to tension on the ligaments of the joint owing to a slight degree of subluxation of the joint, the sacrum being rotated downwards and forwards relative to the ilium on the affected side. It occurs most frequently in women after childbirth, but it is not uncommon in men following a twisting strain. The distinguishing features are: that the local tenderness will be over the posterior ligament of the joint just medial to the posterior inferior spine of the ilium; all movements will be free and painless except rotation; and finally, referred pain when present will be to the outer side of the thigh and into the groin – an odd and unexplained distribution that cannot occur with any single disc prolapse.

3. Senile Osteoporosis

In this condition absorption of calcium from the bones may weaken their structure so much that pathological crush fractures of

the vertebral bodies occur. It may affect even middle-aged people and the presence of secondary deposits is often suspected. If there is any doubt about the diagnosis deep X-ray therapy should be given, for it does seem to have a beneficial effect in either case.

For a detailed discussion of the differential diagnosis of pain in the back the textbooks should be consulted. Of the pathological conditions that should always be borne in mind the most important are tuberculosis of the spine, anchylosing spondylitis and secondary neoplastic deposits. In regard to the latter it should be noted that the X-ray appearances may remain normal even when the spine is riddled with deposits.

There is a further factor that should be considered in all long standing cases of pain in the back. Under normal conditions the great majority of sensory impulses are inhibited from reaching the level of consciousness. This normal censorship breaks down if one's attention is focused on the part from which they arise, or if the afferent pathway is, as it were, well trodden by constantly repeated impulses. Thus painful stimuli constantly travelling up the same pathway will reach the level of conscious perception with increasing facility the longer they continue, especially when one's anxious attention becomes focused upon them.

For example, a hack on the shin when one is about to score a goal at soccer will not even be felt at the time because one's attention is focused elsewhere and the inhibitory mechanism is exerting a complete censorship. If the same blow were delivered when one was sitting down doing nothing, one would feel intense pain immediately. But the actual painful afferent stimuli are the same in both cases.

Thus after long continued back pain, not only are the afferent pathways greatly facilitated, but the patient's attention tends to become permanently focused for their full acceptance and appreciation – so that the stimuli which result from the mild backache of fatigue, which are scarcely noticed under normal conditions, become real pain to the chronic sufferer. In such cases one needs some means, psychological or chemical, of breaking down the circuits and opening the nervous synapses so that the normal inhibitory mechanism can again function.

These physiological factors make the assessment of chronic cases of backache extremely difficult and it is tempting to dismiss them as 'neurotic'. Any neurosis present, however, is far more often the result of the pain, not the cause of it. Nothing is more dramatic in

surgery than the change in a patient's mental outlook following, for example, a successful laminectomy.

CERVICAL DISC LESIONS

The cervical spine is the next most common site for intervertebral disc lesions after the lower lumbar region. While their pathology is similar to such lesions in the lumbar spine they present special features of their own and special problems in treatment. Cases present themselves in two main groups: early cases of degenerative disc lesions with or without prolapse, and late cases where the symptoms result from secondary osteoarthritic changes.

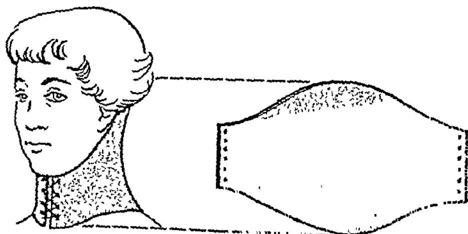


Fig. 4

CERVICAL COLLAR

This is cut from a sheet of sponge rubber about $\frac{3}{8}$ inch thick. It can be covered with lint or chamois leather. A shoe lace can be used to lace it up in front.

1. Cervical Disc Prolapse

The most important feature of a disc prolapse in the cervical region is its liability to cause pressure on the spinal cord as well as on the emerging nerve roots. Thus the neurological effects may comprise pain and dysfunction in the area of distribution of a cervical nerve root, or signs of cord pressure such as weakness in the legs and disturbance of bladder function, or a combination of both. Owing to the risks of serious damage to the spinal cord, these cases require more careful and cautious management than disc lesions elsewhere in the spine. Bed rest is the first essential. This may be combined with gentle continuous traction using a head halter. When the symptoms

have subsided some form of cervical support should be provided before the patient is allowed up. This presents a problem, as it is so difficult to support the cervical spine both adequately and comfortably. Moulded plastic collars are often prescribed, but like most such appliances there is a tendency for the patient to say: 'The doctor's coming today; I must put on my collar.' A sponge rubber collar (Fig. 4) does not immobilize so well, but it does provide comfort as well as support so that the patient will in fact wear it. It is thus, from the practical point of view, more useful than an expensive surgical appliance which is kept in a cupboard. Moreover it can be made cheaply on the spot. A plaster of Paris cast or a rigid surgical appliance is, however, desirable for the more severe cases and especially those that have shown signs of cord pressure.

Surgical intervention is occasionally indicated for persistent cases, but the prognosis is not so favourable as it is in lumbar disc lesions. Fortunately the great majority of cases eventually respond to conservative measures.

2. CERVICAL ARTHRITIS

Osteoarthritic changes are very common in the middle-aged and elderly, especially in the joints between C.5, 6 and 7. Although usually symptomless, pain may arise as a result of minor mechanical derangements or an inflammatory reaction of the 'rheumatic' type. In either case pain in the neck itself may be accompanied by referred pain due to irritation of adjacent nerve roots, but there are rarely any signs indicative of pressure on a nerve root. The distribution of the referred pain may be to the back of the head; the shoulder region; or down the arm, according to the level of the primary lesion. The terms 'occipital headache', 'rheumatism of the shoulder' or 'brachial neuritis' should always make one think of the cervical spine.

Since the symptoms which may occur in these osteoarthritic lesions are often due to the presence of fibrous adhesions, a manipulation of the cervical spine frequently gives dramatic relief of pain. It should not, however, be undertaken if there is evidence that some inflammatory reaction is present. This should be suspected if the pain is of a continuous aching character which persists even during rest and is associated with guarding muscle spasm. Treatment then consists in rest, heat and analgesics. Although a period of bed rest may be necessary in acute cases, a sponge rubber collar to provide 'local' rest is again a most useful appliance.

CHAPTER III

CHRONIC ARTHRITIS AND RHEUMATIC AFFECTIONS

If any piece of machinery is made to work after it has sustained some damage, it will eventually exhibit signs of wear, the rapidity of the wearing-out process being dependent upon the extent of the damage, the amount of work it has to do, and the stress under which its work is carried out. In the joints of the human body these wear and tear changes will be accompanied by changes resulting from the reaction of the tissues of the joint to the altered mechanical conditions. The clinical picture is further complicated by changes which are the direct result of the original trauma. In any particular case it is usually possible to differentiate the pathological changes due to these three factors:

1. Mechanical Wear

If the opposing joint surfaces no longer fit accurately, as, for example, after a fracture, or if the lubricating quality of the synovial fluid is altered, as in rheumatoid arthritis, the articular cartilage will be worn away by friction. This is the main reason why osteoarthritic changes are much more common in the weight-bearing joints of the lower limb than in the arm.

2. Reaction of the Tissues

All tissues respond in the same way to excessive pressure. If the pressure is intermittent, hypertrophy takes place. In the skin this results in the formation of callosities. In the case of joints it is at the edges of the articular surfaces that any excessive pressure will be intermittent in character. Hence the formation of osteophytes, which are essentially callosities on bone.

In the central areas of the articular surfaces any excessive pressure will be more continuous, leading to atrophy of the articular cartilage and thus adding to the changes resulting from mechanical friction.

Thus in an arthritis which is entirely mechanical in origin, such as that resulting from a fracture through the articular surfaces, there will be a progressive wearing away of the cartilage over the main

weight-bearing areas, combined with hypertrophic changes around the margins of the joint with the formation of osteophytes and hypertrophied synovial fringes, together with fibrosis of the capsule.

3. Pathological Changes

Often the original cause of damage is not a direct injury but some pathological condition that interferes with the mechanical efficiency of the joint tissues. In cases of infective arthritis the damage may be of an obvious mechanical nature resulting from actual destruction of parts of the articular surfaces. There is, however, a large group in which the damage appears to be the result of nutritional or metabolic disorders, as for example in rheumatoid arthritis. In these cases the articular cartilage is particularly affected, becoming softened, fibrillated and split into irregular fissured fragments. In contradistinction to the changes resulting from pure mechanical wear, these pathological changes are more likely to occur in non-weight bearing areas. Cartilage normally obtains most of its nourishment from the synovial fluid. Friction and movement appear to play an important part in assisting the transudation of fluid between synovial fluid and cartilage.

Treatment

Osteoarthritis is thus a degenerative process which is primarily mechanical in origin. Since the changes which occur are irreversible treatment can only be symptomatic. The two symptoms for which the patient seeks advice are pain and stiffness. It is important to realize that the osteoarthritic process itself is painless, but although it may progress to an advanced degree before any pain is experienced, in most cases painful symptoms ultimately supervene. There are four common causes of pain arising in an osteoarthritic joint:

1. Nipping of sensitive tissues between the joint surfaces. Usually it is the hypertrophied synovial fringes around the margins of the joint that get caught between the roughened and osteophytic articular surfaces.

2. Stretching of the contracted capsule or of fibrous adhesions that have formed within the joint.

In both cases the pain will be induced by activity and relieved by rest. The precise diagnosis can usually be determined by the site of the pain and the nature of the movement which causes it. Thus, for

example, if extension of the knee causes pain at the back of the joint it is most likely to be due to stretching a contracted capsule, while if it occurs in the front of the joint it is probably due to nipping of a synovial fringe. In both cases treatment consists in trying to mobilize the joint by manipulation combined with active physiotherapy, though it is sometimes justifiable to excise the affected synovial fringe.

3. Pain due to inflammation. Osteoarthritic joints are prone to recurrent inflammatory episodes. The inflammation may be reflex in nature, the stimulus being pain of mechanical origin; it may be due to recurrence of the inflammatory condition which caused the original damage, as with rheumatoid arthritis; finally, osteoarthritic joints are particularly susceptible to inflammatory episodes of a rheumatic nature.

The treatment in all such cases consists essentially in rest and the application of heat, while an endeavour is made to determine the cause of the inflammation.

4. In any condition in which sclerosis of either fibrous tissue or of bone occurs aching pain is likely to occur, especially when the part is warm, and would seem to be due to hyperaemia of the tissues. This is the type of pain commonly associated with chronic osteomyelitis, Paget's disease and bone tumours. It is of a continuous aching character, unaffected by activity and is characteristically worst at night. It is not uncommon in osteoarthritic joints. Deep X-ray therapy appears to be the only way of relieving this type of pain.

There is thus no treatment for osteoarthritis as such, but only for such symptoms as may arise in an osteoarthritic joint. A diagnosis of osteoarthritis is therefore insufficient from the point of view of treatment, until the cause or causes of pain in the particular case have also been defined.

It is equally important to explain the nature of their affections to the patient, for to the layman arthritis means rheumatoid arthritis. Thus a patient who in the past has, say, fractured an ankle and has subsequently developed wear and tear changes in the joint may see an X-ray report which says 'arthritic changes in the ankle joint'. They at once visualize themselves as being the future victims of a spreading and crippling disease, and may not even dare to voice their dread of what they imagine is in store for them.

It should be explained to them that the changes in the joint are due to wear and tear resulting from previous damage and cannot, therefore, affect any other joint unless it has also been damaged.

RHEUMATOID ARTHRITIS

This baffling disease only enters into the realms of orthopaedics owing to the *crippling deformities and loss of function to which it* may give rise. In the present state of our ignorance of its aetiology treatment can only be symptomatic. In the majority of cases reasonable function can be preserved until the disease itself dies out, provided that stiffness and deformity are kept to the minimum. The essential consideration is to keep all the affected joints gently active within the limits of pain, while at the same time controlling pain by adequate amounts of analgesics such as aspirin. Splints should be used only during resting periods. The above may sound obvious but it remains a fact that many patients develop their worst deformities and final loss of function while undergoing intensive investigation in hospital! Whenever possible patients should be treated at home and should be encouraged to do as much for themselves as possible. Special watch should be kept for the development of *flexion deformities of the hips and knees, which occur so rapidly if* the patient is allowed to remain propped up in bed or sitting in a chair all day. Periods of prone lying are very useful in preventing *such deformities.*

If deformities do occur their surgical correction should be delayed until the disease is reasonably quiescent. All necessary measures should then be carried out during one period in hospital, so that they do not suffer the repeated setbacks which any surgical procedure inevitably causes.

LOCAL RHEUMATIC AFFECTIONS

Amongst the 'rheumatic' group of diseases there is a large number of local conditions that constantly plague patients, doctors and specialists alike. Although their aetiology remains obscure they all appear to be the result of an abnormal response of the tissues to stress. This abnormal reaction is believed to be due to defects in the composition of the tissues, which are primarily nutritional in origin. Fibrous tissues are most commonly affected, but the synovial lining of joints and tendon sheaths may be involved primarily or secondarily. In the present state of our lack of knowledge as regards their

aetiology classification is difficult, but they can be considered as falling into four main groups.

I. THE 'TENNIS ELBOW' OR MUSCLE GROUP

In the common variety of tennis elbow the symptoms arise from a localized sensitive spot in the attachment of the extensor carpi radialis to the lateral epicondyle of the humerus. It often follows a strain or some unusual activity and may be regarded as a chronic strain of the muscle attachment. Once the symptoms have been induced they seem to be kept up by reflex action — the pain on use causing a local reflex inflammatory response which in turn makes the spot more sensitive. Various methods of treatment are effective in a proportion of cases: manipulation to break down any fibrous adhesions which may have formed: injection of local anaesthetic to break the reflex arc, combining this with hydrocortisone to reduce the inflammatory reaction: or tenotomy of the muscle origin.

It should be noted that there is another form of tennis elbow in which the symptoms are due to nipping of the synovial fringe of the radio-humeral joint.

A condition similar to tennis elbow may occur in other situations. The commonest are:

1. Calcaneal Fasciitis

The tender spot lies under the heel at the point of attachment of the plantar fascia. The above methods of treatment may be used combined with the provision of a sponge rubber long arch support incorporating a heel pad hollowed out under the tender spot. It is, however, extremely resistant to all treatment. The so-called calcaneal spur which is sometimes seen on X-ray is the result, not the cause, of the condition.

2. Ischial Tuberosity

The pain and tenderness are localized to the origin of the hamstrings, but there may be some referred pain down the thigh which may superficially suggest sciatica and a 'disc lesion'.

3. The Lower Pole of the Patella

In the centre of the ligamentum patellae.

4. Over the Back of the Sacrum

Or along the posterior part of the iliac crest.

II. THE FIBROUS TISSUE GROUP

In this group the clinical picture varies according to the particular type of tissue affected. This may be the capsule of joints, the fibrous sheaths of tendons, fascial planes, or in the substance of the tendons.

The pathological changes consist in a low grade inflammatory reaction combined with a fibroblastic proliferation, new fibrous tissue which has a firm and translucent consistency being laid down between the original fibres. Where joint capsules are involved the changes are mainly of an inflammatory nature, whereas in tendon sheaths, tendons and fascial planes it is the thickening of the tissues which is the predominant feature.

1. Capsulitis

This occurs most commonly in the shoulder joint producing the well-known 'frozen shoulder'. The inciting cause may be an acute tendinitis of one of the tendons of the rotator cuff, usually the supraspinatus, or any other injury to the joint, though sometimes it appears to start spontaneously. The low grade inflammatory reaction which develops in the capsule of the joint lasts for a variable period, usually about six months. Progressive stiffening occurs as a result of fibrous thickening of the capsule and secondary involvement of the synovial membrane whose folds become adherent. Microscopic sections show a non-specific inflammatory reaction in the tissues with a round cell infiltration.

Treatment

During the inflammatory stage any form of active treatment merely serves to aggravate the condition. Theoretically the arm should be splinted in abduction, but no patient will tolerate this for months on end. The application of heat combined with light massage helps to relieve pain. The 'anti-rheumatic' drugs such as aspirin, butazolodine and hydrocortisone are used with varied success.

Once the inflammatory stage is over, active measures can be undertaken to overcome the stiffness. The time to start active treatment is when there is no longer pain while at rest and no muscle spasm. Heat followed by active assisted movements form the basis of treatment, with one or more manipulations under an anaesthetic if necessary. Although manipulation is often effective it does carry the risk of lighting up the inflammation again, and there is a growing feeling that many cases may do just as well in the end if left alone.

A similar inflammatory thickening of the capsule may occur in other joints, especially the metatarsophalangeal joints of the toes (p. 69). It is likely to give rise to confusion in diagnosis owing to its resemblance to an early rheumatoid arthritis. This condition, however, never affects more than two or three joints at the same time and there is no rise in the blood sedimentation rate. Occasionally it may be associated with a chronic fasciitis or tendinitis.

2. TENDINITIS

Acute

The acute form is an inflammatory response to trauma or unaccustomed over-use. It usually responds rapidly to rest and the application of heat, short wave diathermy being the most effective. Occasionally it progresses into the chronic form.

Chronic

Persistent symptoms of tendinitis are usually associated with the development of pathological changes in the substance of the tendon. In some cases a fibroblastic proliferation between the fibres of the tendon produces a tender fusiform swelling which persists for months and is resistant to all forms of treatment. This occurs most commonly in the Tendo-Achilles.

In other cases degenerative changes occur which may eventually result in pathological rupture of the tendon; or a calcareous deposit may form in its substance. Such deposits may induce considerable osmotic pressure within the tendon, giving rise to intense pain. This occurs most frequently in the supraspinatus tendon. It is also occasionally seen in intervertebral discs. The deposit may eventually be absorbed spontaneously, especially if the part is rested. Persistent symptoms may sometimes be relieved by evacuating the deposit by suction using a wide bore needle, or by surgical removal if this fails.

3. TENOSYNOVITIS

An acute tenosynovitis resulting from sudden over-use nearly always settles down rapidly without treatment and there is no need to advise rest. In fact it is better to continue activities.

In chronic tenosynovitis a localized thickening forms in the fibrous sheath which impedes free action of the tendon. This is most frequently seen in the sheath of the extensor pollicis brevis tendon over the radial styloid (De Quervain's disease). It also affects the

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sheaths of the long flexors of the fingers at the level of the metacarpophalangeal joints in the palm. After a period of rest the tendon may become constricted by pressure at the level of the thickening which thus anchors the tendon at this point. The finger thus remains flexed when the other fingers are extended but will suddenly flick into extension when extra force is applied. The condition is known as 'Trigger finger'.

A *similar condition occurs in babies opposite the metacarpophalangeal* joint of the thumb producing fixed flexion of the interphalangeal joint, though this can usually be overcome if considerable force is used.

The treatment in all cases consists in opening the tendon sheath in the length of the thickened part, although occasionally early cases may respond to local injection with hydrocortisone.

4. FASCIITIS

A chronic fasciitis may occur in the palmar or the plantar fascia, though the clinical features are different in the two cases:

a. PALMAR FASCIA – DUPUYTREN'S CONTRACTURE

In this condition a fibroblastic proliferation occurs in the palmar fascia producing longitudinal thickened bands in the palm. The slips of fascia which extend into the fingers also become involved and as they gradually contract flexion deformities occur at the metacarpophalangeal and proximal interphalangeal joints. The overlying skin becomes firmly adherent to the thickened fascia. The palmar fascia opposite the fourth finger is usually affected first, a firm nodule appearing in the fascia opposite the distal palmar crease. This gradually extends to form a longitudinal band. Further bands of thickening may then develop affecting the fifth finger, and occasionally the third. The slips of fascia extending into the thumb may also be involved. Eventually the affected fingers may become so flexed that the distal joints are hyperextended by pressure of the palm.

Treatment

As the condition usually affects middle-aged or elderly men and its progress may be very slow, treatment is not always necessary. Progressive contracture in younger patients should be dealt with by surgical excision of the whole area of the affected palmar fascia. A course

of X-ray treatment after healing has taken place seems to help in lessening the likelihood of recurrence. Occasionally X-ray treatment alone may arrest the progress of the condition sufficiently to render surgery unnecessary.

b. Plantar Fascia

Although plantar fasciitis occurs in a form rather similar to that of Dupuytren's contracture in the hand, its course and clinical features are rather different. There is more inflammatory reaction and more swelling but much less tendency to contracture. On examination a tender elongated mass of tissue can be felt in the line of the plantar fascia. The microscopical appearance is indistinguishable from that of a chronic tendinitis and the condition runs a similar course, eventually resolving spontaneously though it may leave some permanent thickening of the fascia. It is extremely resistant to all forms of treatment.

III. SYNOVIAL GROUP

The synovial lining of joints and tendon sheaths is frequently the seat of an inflammatory reaction resulting from trauma or infection. In addition it is liable to a variety of other affections. Although they should not all be classed as belonging to the rheumatic group of diseases it is convenient to consider them here.

1. Chronic Non-Specific Synovitis

Two distinct clinical types are encountered.

a. Intermittent Hydrarthrosis

In this condition recurrent effusions take place into one of the larger joints, usually the knee. Occasionally two or three joints may be affected. The condition may persist for years with little change in the joint tissues apart from some thickening of the synovia, though in some cases a true rheumatoid arthritis may ultimately appear.

Short periods of rest when necessary, combined with aspiration of the fluid, is the usual regime of treatment. Replacement of the fluid with a small quantity of air sometimes has a markedly beneficial effect. In severe cases a complete synovectomy may be indicated.

b. Hypertrophic Synovitis

This type is characterized by a gradual onset, with marked oedema

and thickening of the synovia but little effusion. The clinical picture closely resembles that of synovial tuberculosis or an early rheumatoid arthritis, but all investigations prove to be negative and after persisting for one to two years the symptoms may gradually subside. Again one of the large joints is usually affected, most commonly the knee. Its importance lies chiefly in the differential diagnosis. Apart from a synovectomy for persistent cases, treatment can only be symptomatic.

2. OSTEOCHONDROMATOSIS

This condition is characterized by the development of cartilaginous loose bodies which may eventually develop a bony core.

In one type only a few large loose bodies are formed. The synovial membrane appears to be normal, and there is usually a history of previous trauma to the joint.

In other cases large numbers of small cartilaginous nodules appear in the tips of hypertrophied synovial villi. They eventually break off to form loose bodies in the joint, sometimes in hundreds. It has been suggested that the condition is due to the persistence of mesenchymal rests in the synovial membrane.

These conditions occur most commonly in the knee and elbow joints, though any large joint may be affected. When only a few loose bodies are present their removal is attended by a reasonably good prognosis. When a large number are present a complete synovectomy is worth while, but recurrence is likely and eventually arthrodesis of the joint may be necessary.

3. SYNOVIOMA

A benign type of synovial tumour, the giant-cell synovioma, usually forms a localized encapsuled mass, but it occasionally occurs in a diffuse form filling the cavity of the joint, usually the knee. It may then give rise to confusion in diagnosis as it may at first suggest a hypertrophic synovitis. Treatment consists in local excision, but it must be remembered that it also occurs in a malignant form. Microscopic sections should, therefore, always be made from the material removed.

IV. GANGLIONS AND CYSTS

A ganglion is the result of a mucoid degenerative reaction in fibrous tissue, which usually follows some form of trauma. They

usually arise from tendon sheaths or the capsules of joints. Sometimes a single cyst is formed, filled with jelly-like material. In other cases a number of small cystic spaces develop, surrounded by a fibrous capsule.

The commonest sites are the back of the wrist and in the foot, but cysts of the semilunar cartilages of the knee are also really ganglia.

Bursting a ganglion by sudden pressure will sometimes effect a cure. A less traumatic method is to aspirate the contents through a large bore needle after perforating its wall in several places. Excision of the ganglion is more certain in its results, though even then recurrence is not uncommon, and it should only be advised if the ganglion is causing persistent pain or inconvenience.

Other so-called simple cysts in connection with joints are most commonly the result of synovial fluid leaking into a normal bursa which communicates with the joint, as in the case of the semi-membranosus bursa. Persistence of such swellings can usually be traced to some condition in the joint itself which is giving rise to a synovial effusion.

CHAPTER IV

AFFECTIONS OF INDIVIDUAL JOINTS

In this chapter it is proposed to consider some of the special features of individual joints, both as regards their mechanics and their common disabilities.

THE SHOULDER

Mechanics

The shoulder joint should be considered as one part of a complex mechanism which enables the arm to be moved into positions in which the hand can be used. This mechanism comprises the shoulder *joint itself together with the means whereby the scapula is moved* and rotated on the chest wall about the two pivots formed by the acromio-clavicular and sterno-clavicular joints. From the functional and clinical point of view the most important movement is that of abduction in the plane of the scapula, i.e. the movement necessary for saluting or downing a tankard of beer. This movement is initiated at the shoulder joint by the supraspinatus, the deltoid later taking over to complete the movement up to 90° of abduction, which is the maximum possible at the shoulder joint itself. Raising the arm above the head from this position is accomplished by contraction of the serratus anterior which rotates the scapula on the chest wall.

Failure of supraspinatus will prevent the movement being initiated, though if the arm is passively abducted the deltoid will be able to maintain the abducted position. Paralysis of the deltoid will limit abduction to about 30°, while if the serratus anterior is paralysed active abduction will not be possible above 90°.

Owing to the free range of scapular movements, fixation of the shoulder joint itself is not a severe disability provided that the scapular muscles are not paralysed, and the joint is fixed in the optimum functional position which is one of 70° of abduction in the plane of the scapula. [illegible]
ment can be achievec [illegible]
in a good position. I [illegible]
joint than a stiff one, for the latter is likely to be painful, and this will inhibit movements of the scapula as well.

This illustrates an important point that affects the surgery of many joints – patients rarely *complain* of the absence of movement at one joint provided that it is painless. In fact with joints such as the shoulder and hip they often state that it moves more freely after it has been arthrodesed.

DISABILITIES

Since the shoulder joint is not weight bearing and has such free mobility it is not subjected to mechanical stress and is thus very rarely the seat of osteoarthritic changes. Indeed a diagnosis of 'arthritis' of the shoulder is usually wrong. In clinical practice pain arising in the region of the joint is nearly always due to one of three conditions:

1. *The Supraspinatus Syndrome*

The tendon of the supraspinatus is a very hard used structure. Not only does the muscle initiate the movement of abduction, but it also has to hold the head of the humerus down against the upward thrust of the deltoid. Sudden resistance to the movement of abduction will put severe strain upon it so that partial or complete tears of the tendon are common. Moreover, if as a result of over-use, the muscle gets tired, the head of the humerus will tend to ride up causing both pressure and friction between the tendon and the under surface of the acromion. This may set up a tendinitis or a subacromial bursitis.

Three different clinical pictures can be recognized:

(i) Due to complete rupture of the tendon. There will be inability to initiate the movement of abduction; though if the arm is abducted passively further active abduction will then be possible through the action of the deltoid. Pain will not be a marked feature and may be absent.

(ii) Due to partial tears or tendinitis. There will be pain on active abduction of the arm up to about 70°; thereafter further abduction will be painless (the painful arc syndrome). Passive movements will be painless.

(iii) Due to subacromial bursitis. All abduction movements both active and passive will be painful. Sometimes of course (ii) and (iii) will be combined.

2. *Capsulitis* (*The Frozen Shoulder*)

See p. 28.

3. *Inflammation of the Acromio-Clavicular Joint*

This is quite common and is often mistaken for a lesion of the shoulder joint itself. It usually develops following some minor injury and has the same pathology as capsulitis of other joints. There will be quite marked thickening of the joint capsule with acute local tenderness.

THE ELBOW

The mechanics of the elbow joint are comparatively simple and call for no special comment. The joint has, however, one special feature that distinguishes it from all other joints. After any form of trauma the subsequent inflammatory response is likely to persist, especially in the tissues in the front of the joint, which remain swollen and tender with protective spasm in the biceps and brachialis muscles. Any stimulus such as massage or movements will exacerbate the condition, so that one is faced with the paradox that the only way to restore movement is to immobilize the joint until the reaction has settled. If it is allowed to progress new bone may form at the front of the lower end of the humerus which will cause permanent limitation of flexion (myositis ossificans). It should therefore be a rule that no active treatment is ever given following any injury to the elbow, especially in children, except those movements which the patient can carry out himself without pain.

THE WRIST

The wrist is really two joints in series. That between the first row of the carpus and the radius on the one side, the second row of the carpus on the other.

Its mechanical equivalent is shown in Fig. 5a and b. The advantages of this arrangement are that, since the movements are divided between two joints they can each have smaller joint surfaces; and also that there will be less tendency for the soft tissues to be compressed in the angle formed when the joint is flexed. It has the disadvantage that it tends to be unstable and to buckle when subjected to a compression force (Fig. 5c). In the wrist this tendency is resisted by the various joint ligaments and by the scaphoid which spans the two rows of carpal bones rather like the link of a bicycle chain (Fig. 5d). The power of the grip is, however, limited by the strength of this mechanism rather than by the power of the muscles. This is why an excessive gripping effort is likely to produce pain in the wrist, the

pain being due to the sudden stretch on its ligaments when it begins to buckle.

When a severe and sudden compression force is applied, as by a fall on the outstretched hand, the controlling mechanism may give

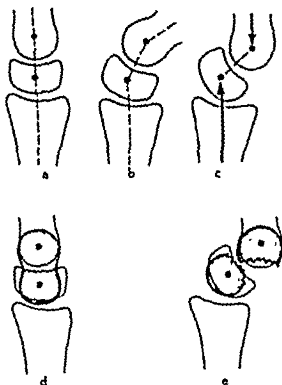


FIG 5

MECHANICS OF THE WRIST JOINT

(a and b) The wrist joint consists of two joints in series The centre of rotation for movements of flexion and extension between the carpus and the radius is in line with the centre of the semilunar, while that for movements between the first and second row of the carpus lies at the centre of the head of the capitate

(c) When subjected to a compression force, the two joints may get out of phase, movements taking place in opposite directions. This will tend to sublux and finally dislocate the semilunar.

(d and e) The scaphoid overlaps the two centres of rotation like the link of a bicycle chain. If the movements get out of phase and its attachments to the capitate and semilunar do not give way, a fracture must occur across the waist of the bone.

way and 'buckling' occurs (Fig. 5e). It will be seen that unless the ligamentous attachments of the scaphoid to the capitate and semilunar rupture, a fracture must occur across the waist of the scaphoid. Its proximal fragment, and the semilunar to which it is firmly attached,

will then become at least momentarily displaced forwards. This is the mechanism by which fractures of the scaphoid occur. Sometimes its attachments to the semilunar give way first. A forward subluxation or dislocation of the semilunar then takes place without fracture of the scaphoid.

The pain which is likely to persist in cases of un-united fractures of the scaphoid is due to strain on the fibrous union when it tries to resist this buckling effect. In such cases, and also in those where the semilunar has suffered a loss of its blood supply following a similar type of injury and degenerative changes have occurred, an excision of the whole of the proximal row of the carpus offers the best solution. This results in the production of a simple hinge joint between the radius and the second row of the carpus. Although it has a smaller range of movement than the normal wrist, it is strong, stable and nearly always painless.

This type of procedure is not indicated in the presence of arthritic changes. Arthrodesis is the final answer for the arthritic wrist that fails to respond to conservative measures. Since during most activities the wrist is held in a fairly constant position of slight dorsiflexion, fixation of the joint gives rise to little disability except in certain occupations, for example violinists and mechanics.

THE THUMB

The essential function of the thumb is its ability to adopt a position of opposition to permit objects to be held between it and the fingers. This function may be upset either by paralysis of the controlling muscles, especially the opponens pollicis, or by a painful arthritis affecting the carpo-metacarpal joint. Osteoarthritic changes are common in this joint, especially in the middle-aged housewife. Indeed the condition might well be called housewife's thumb. The most effective remedy consists in the provision of a moulded perspex [illegible] working hours to protect the [illegible], wet or [illegible] lasty or arthrodesis of the joint.

When function is affected by paralysis of the opponens pollicis, various types of tendon transplant can be employed, or, if no suitable muscles are available, arthrodesis of the carpo-metacarpal joint, with the thumb held in a position of opposition, will restore good function to the hand.

THE HIP

The hip joint and its controlling muscles have two distinct functions to perform: 1. To permit and to effect movements of the lower limb on the trunk in all directions, hence its construction as a ball and socket joint. 2. To maintain balance when the weight of the body is borne on one leg. This is effected by the abductor mechanism whereby the pelvis is elevated on the opposite side in order to tilt the trunk over on to the weight-bearing leg (Fig. 6). If this

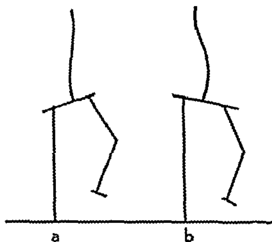


FIG. 6

THE ABDUCTOR MECHANISM OF THE HIP JOINT

(a) When standing on one leg the pelvis is tilted by contraction of the abductors to bring the centre of gravity of the body over that leg

(b) If this mechanism fails the pelvis will drop on the opposite side instead of being raised. Balance can then only be maintained by inclining the trunk towards the weight-bearing leg.

mechanism fails the pelvis will drop on the opposite side when weight is borne on one leg (Trendelenburg sign). Balance can then only be maintained by an inclination of the spine towards the weight-bearing leg. When walking the individual is compelled to lurch towards the affected leg each time that this leg takes the weight. When both hips are affected a waddling gait is produced, the individual lurching to the side of each leg in turn as it takes the weight (the Trendelenburg gait) – or duck waddle.

The common causes of failure of the abductor mechanism are:

1. An unstable joint, as in congenital dislocation or following destructive disease.

2. Defects in the femur which render it unable to support the weight, i.e. fractures of the femoral neck or slipped femoral epiphysis.
3. Paralysis of the abductor muscles, especially gluteus medius.

The preservation of this important mechanism is one of the major problems in reconstructive surgery of the hip.

Chronic Arthritis

Being a weight-bearing joint, the hip is commonly affected by osteoarthritic changes which cause progressive pain and stiffness. The joint tends eventually to adopt a position of lateral rotation and adduction, the latter giving rise to apparent shortening of the limb.

Treatment should be directed primarily towards the relief of pain. If pain is only present during activity indicating its mechanical origin, a manipulation of the joint under thiopentone anaesthesia often gives marked relief. Many patients can be kept going for years by an occasional manipulation.

As in all osteoarthritic joints inflammatory episodes are common. Pain is then of a more continuous character and is associated with guarding muscle spasm. In such cases a short period of rest combined with the administration of short wave diathermy is usually the most effective measure.

If the pain occurs mainly at night when the part is warm, deep X-ray treatment may be indicated. It is probably inadvisable, however, if surgical measures may have to be contemplated later.

Many other forms of treatment have been advocated, but in general it may be said that they are rarely of much help unless they necessitate the patient's admission to hospital, when it would seem that it is the period of enforced rest that is mainly responsible for any improvement that occurs.

Surgical Treatment

There are three main alternatives:

1. *Arthrodesis*

This is by far the most satisfactory procedure at present available for the majority of cases, especially in the younger patient.

When properly performed using internal fixation, there should be over 90% of successful results, no external immobilization is usually necessary, and the patient should be on his feet again within ten weeks or less. The disability that a fixed hip entails is surprisingly slight.

The patient can take part in all normal activities including driving a car and can walk without a limp and without a stick. Although it is often difficult to get patients to realize the benefits they will derive from this operation, there are no more grateful patients than those who have had an arthrodesis of the hip.

The operation is, however, contra-indicated in the very elderly, when there is stiffness of the knee joints, in some cases where there is also a severe arthritis of the spine – and of course in bilateral cases arthrodesis of both hips would produce a severe disability. Finally, some types of arthritis may present severe technical difficulties which would make it difficult to achieve fusion.

2. *Osteotomy*

In the McMurray osteotomy the femur is divided just above the level of the lesser trochanter in a slightly oblique direction, and the shaft is displaced medially under the head and neck of the bone. In order to avoid a long period of immobilization in plaster some form of internal fixation is usually employed. It is difficult to explain why the procedure should relieve pain, but it certainly does so in a high proportion of cases. The patient, however, still has an arthritic hip, and the range of movement may be very limited. Moreover, it is not always easy to avoid some subsequent stiffness of the knee.

Although many surgeons favour this procedure, owing to the fact that some movement is preserved at the hip, it does not give such a strong and reliable hip as an arthrodesis. It is especially useful in bilateral cases, and for un-united fractures of the neck of the femur.

3. *Arthroplasty*

The reconstruction of a new joint is obviously an attractive ideal to work for. Although a tremendous amount of work has been done on many different types of arthroplasty, no method has yet been proved to give consistently successful results that will stand the test of time.

Although excellent results can be obtained in suitable cases, for some time to come it must remain an alternative for those cases which are unsuitable for arthrodesis or osteotomy. It is particularly indicated in bilateral cases and in the elderly. Perhaps the best results are obtained in fractures of the neck of the femur when, owing to avascular necrosis of the head of the bone, union cannot be hoped for. For such cases a replacement arthroplasty using a suitable

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both muscles and ligaments. This explains how momentary locking may occur when the cruciate ligaments are lax or have been ruptured.

2. During flexion from the position of extension the movement at first occurs mainly about the axis y, whereas during the last part of the range it occurs mainly about x (Fig. 7). The tibia therefore moves on a spiral course which is reflected in the shape of the articular surface of the femur, whose radius of curvature becomes progressively shorter from front to back. The tibial articular surface cannot therefore be made to fit that of the femur in all positions. In order to ensure correct lubrication the space that is left is filled by the semilunar cartilages. As they are flexible structures they are able to accomplish this function in all positions of the joint. It must be stressed that the semilunar cartilages play no part in weight bearing, their sole function being to ensure correct lubrication of the opposing articular surfaces.

Disabilities

Internal Derangement

Owing to its complicated structure the knee is particularly subject to abnormalities which may interfere suddenly with its movements. Usually it is the final range of extension that is affected and the limitation may only be momentary or it may persist. In the latter case the joint is said to be locked. The following are the common causes:

Abnormal movements.
Torn, displaced or discoid semilunar cartilages.
Torn cruciate ligaments.
Loose bodies.
Osteochondritis desiccans.
Chondromalacia patellae.
Recurrent dislocation of the patella.
Nipped synovial fringes.
Fibrous adhesions.

The way in which abnormal movements may cause momentary locking has already been discussed.

Lesions of Semilunar Cartilages

The Medial Cartilage

The cartilage is usually damaged by having its anterior and posterior portions separated, thus straightening out its curve. The

prosthesis to replace the head and neck of the femur will restore good and painless function rapidly and effectively. The convalescent period is then shorter than that following either arthrodesis or osteotomy.

THE KNEE

Mechanics

The movement which occurs during flexion and extension is not that of a simple hinge but rather the resolution of movement about

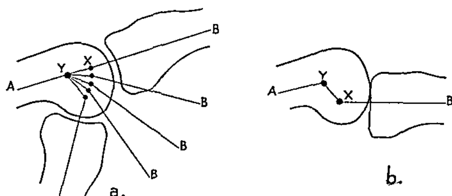


Fig. 7
MECHANICS OF KNEE JOINT

two centres of rotation in series. In Fig. 7, A represents the long axis of the femur and B that of the tibia. It will be seen that the axis x about which the tibia rotates, itself rotates about the axis y (cf. the mechanics of the wrist joint). This is what is meant when it is stated that the tibia both rotates and glides on the femur during flexion and extension.

The advantage of this type of mechanism is that it permits a greater degree of flexion without compressing the tissues at the back of the joint. It does, however, give rise to certain complications:

1. If during the movement of extension the angular movement of the tibia about the axis x should get ahead of the forward gliding movement, the front edge of the articular surface of the tibia will become impacted into that of the femur (Fig. 7) causing momentary locking of the joint, which can be released by flexing the knee again. Movements of the knee therefore require exact control by

Diagnosis. Unless the patient is seen very soon after the receipt of the injury, the history is often of more importance than the examination of the knee. The most significant points are, the type of injury – i.e. a twisting strain, locking of the joint which may be repeated on a number of occasions, and the site of pain.

On examination in a recent case there will be evidence of some degree of reaction in the joint with an effusion or haemarthrosis, and a tender spot on the line of the cartilage. Four points of special importance should be borne in mind:

1. Under the age of 16 years it is rare for a cartilage to be torn, but a suggestive history of repeated momentary locking is not uncommon, especially in girls. It would seem that in early adolescence the joint ligaments may be sufficiently lax to permit a normal cartilage to slip out of place momentarily.
2. There may be associated damage to the cruciate ligaments, which markedly affects the prognosis.
3. In the presence of a torn cruciate ligament it is often possible to displace a normal cartilage.
4. The tear in the cartilage is usually within its substance (Fig. 8a, b, c). As the cartilage is non-vascular such tears cannot heal. However, if the whole cartilage is torn from the capsule (Fig. 8d) healing can occur if it is properly replaced. In such cases there will be much more severe pain and a considerable joint reaction with a haemarthrosis. There is therefore the paradox, that the less the pain and subsequent reaction in the joint the worse the prognosis.

Treatment. If the joint is locked with limitation of extension, the cartilage or some portion of it is probably displaced and it must be reduced. To effect this the knee is flexed to a right angle. It is then abducted to open up the joint space on the inner side and the tibia is gently rotated in both directions.

If this manœuvre fails an anaesthetic should be given before further attempts are made, for the following reasons:

1. Apparent locking is often simulated by guarding spasm of the muscles. In such cases as the muscles relax under the anaesthetic the joint spontaneously straightens.
2. The manœuvre can be carried out much more gently and easily when the muscles are fully relaxed, thus avoiding further trauma to the joint.

opposite side, thus rotating the femur medially, the posterior part

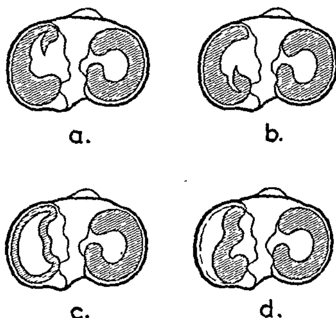


FIG 8

LESIONS OF SEMILUNAR CARTILAGES

Common types of tear of the medial cartilage:
(a) Anterior horn
(b) Posterior horn.
(c) 'Bucket handle'.
(d) Avulsion from capsule

of the cartilage being thrust backwards with it. As the knee will also tend to be abducted the joint space on the inner side is opened up allowing the torn portion of the cartilage to slip laterally between the opposing joint surfaces.

It may be noted that this rotation force which is imposed on the leg when the foot is suddenly caught is responsible for most injuries in the leg which are due to indirect violence. What gives way first depends chiefly on the age of the patient: under the age of 16 – a spiral fracture of the tibia or femur; 16 to 40 a torn cartilage; 40 to 60 a Pott's fracture of the ankle; 60 onwards a fracture of the neck of the femur.

are often disappointing, except in those cases where the anterior ligament has been pulled out with its roots (i.e. fracture of the tibial spine). In such cases the fragment of bone with the attach[illegible]ment can be fixed back into place.

The persistent inst[illegible] [illegible] injuries may also ca[illegible]y derangement as already described (p. [illegible]). [illegible]is gives rise to considerable difficulty and confusion in diagnosis and has resulted in many normal cartilages being excised in error.

Loose Bodies

These are usually cartilaginous but they may have a bony core. They arise in various ways:

1. Portions of articular or semilunar cartilage which are separated by trauma to become loose fragments in the joint cavity.
2. Osteochondromatosis (see p. 32).

Osteochondritis Desiccans. In this condition a flake of bone on a portion of the articular surface becomes separated from the rest of the bone as a result of aseptic necrosis. It is thought to be due to thrombosis of a small end artery resulting from trauma. The overlying portion of articular cartilage degenerates and may also separate to become a loose body with the flake of bone adhering to its undersurface. The condition usually occurs in adolescents and affects the medial condyle of the femur near the intercondylar notch. A similar condition may occur in other joints, most commonly the capitellum of the humerus or the upper surface of the talus.

Chondromalacia Patellae. The articular cartilage of the patella is often the seat of a degenerative process, becoming soft, frayed and eventually worn away. Although it is a common accompaniment of osteoarthritis, it may also occur independently, even in young adults. In such cases the aetiology is obscure but it is probably connected with some metabolic disorder, though trauma also plays a part. It is frequently present in cases of recurrent dislocation of the patella.

Treatment. In young people and in early cases treatment should be conservative. The use of a plaster back slab in conjunction with a course of physiotherapy, such as short wave diathermy, is often effective in at least alleviating the symptoms. In severe and persistent cases it may be necessary to shave off the degenerated layer of cartilage or even to excise the patella.

3. Forcible manipulation as practised by bone-setters on professional footballers usually completes the tear and displaces the torn portion into the intercondylar notch. This permits a fairly rapid return to reasonable function, but the ultimate prognosis is not good.

After reduction the patient is shown how to protect the joint by applying two crepe bandages from the patella to 4 inches below the tibial tubercle. The bandage need *not* be carried above the patella. He is also told to avoid rotatory strains on the joint. With these limitations activity is resumed as soon as symptoms permit.

The Lateral Cartilage

This is less frequently torn than the medial cartilage. The mechanism of injury is usually a medial rotation of the tibia on the femur. Occasionally it is due to a forcible backward thrust on the tibia when the knee is flexed. It may then be associated with a tear of both the posterior [illegible]

A congenital disc[illegible] portion not having been absorbed, as normally happens during development. The symptoms consist in a marked and audible 'click' over the cartilage during movement, and usually first appear in early adolescence. Treatment consists in excision of the cartilage.

The lateral cartilage is also prone to develop a cyst, often multilocular, which is similar to a 'ganglion'. It is due to a mucoid degenerative process usually resulting from previous trauma. They may give rise to vague symptoms with aching pain before they are actually visible or palpable, but rarely cause symptoms of actual derangement. They also occur occasionally in connection with the medial cartilage.

Treatment consists in excision of the cyst and the cartilage from which it arises.

Rupture of the Cruciate Ligaments

The anterior cruciate ligament is usually torn by hyperextension of the knee, while the posterior cruciate ligament is torn by backward displacement on the femur of the flexed tibia. The diagnosis is based on evidence of antero-posterior instability of the joint when tested in a semiflexed position, together with the signs of some severe injury, with a haemarthrosis.

Treatment consists in immobilization of the joint for at least 8 weeks, but the results of either conservative or operative treatment

immobilized. It will then be organized to form fibrous tissue, which will bind the adjoining structures together. Subsequent movements may stretch these adhesions sufficiently to permit a return to normal function, but they will still be present and may be liable to be put on the stretch by some sudden unusual movement. If they are attached to some sensitive structure such as synovial membrane this will cause momentary pain, and the joint may 'give way' owing to reflex inhibition of the muscles.

Between attacks the joint may appear to be normal.

These are the cases that are cured by the bone-setter, who puts the joint through its last few degrees of movement in each direction, the movement being done suddenly so as to snap rather than stretch any adhesions present. The trick is the same as that used to break a piece of string – with a slow pull the string will cut one's fingers, but a sharp jerk will snap the string before any pain is caused.

Chronic Arthritis

Osteoarthritis is as common in the knee as it is in the hip joint, though it may often progress to an advanced stage before giving rise to symptoms. When painful symptoms finally supervene they are most commonly due either to local mechanical derangements (such as the nipping of hypertrophied synovial fringes) or to the recurrent inflammatory episodes to which such joints are liable. In the former case exact diagnosis is essential before any effective treatment can be given. This is often difficult and may requre careful investigation. It must always be remembered that even though a joint shows osteoarthritic changes it does not mean that it is necessarily painful. It is often possible to convert a painful arthritic joint into a painless, though equally arthritic one, by some simple procedure such as breaking down some fibrous adhesions or removing a loose body.

If, however, it is considered that the symptoms are primarily inflammatory rather than mechanical in origin, a period of rest, or partial splinting, together with the usual anti-inflammatory measures is indicated.

Once again, therefore, it must be stressed that 'osteo-arthritis' is not sufficient as a clinical diagnosis. The use of this label demands that one should then define the cause of pain in that particular osteoarthritic joint.

Surgical measures are chiefly indicated for the removal of some local cause for pain. Patellectomy is sometimes indicated when the

Recurrent Dislocation of the Patella

Recurrent dislocation or subluxation of the patella occurs in young adults, most commonly women. The patella almost invariably slips laterally over the lateral femoral condyle. The dislocation is usually momentary. Between attacks the joint shows no obvious abnormality, which may render the diagnosis doubtful and the patient's description of what happens may be very vague.

There is, however, one physical sign that is characteristic and very helpful in doubtful cases – an attempt is made to push the patella laterally. Some abnormal laxity may be noticed, but the significant point is that the patient will immediately try to stop your doing so. This immediate reaction on the part of the patient is diagnostic of this condition. Surgical treatment is nearly always successful in achieving a permanent cure.

Nipped Synovial Fringe

In most joints the spaces around the margins of the articular surfaces are filled by projecting fringes of the synovial membrane. These are occasionally liable to get nipped between the articular surfaces, especially when the latter have become roughened as a result of arthritic changes. In the knee it is most likely to occur around the margins of the patella or in connection with the infrapatellar pad of fat. In the latter situation, as a result of repeated small haemorrhages into the fatty pad, it may become thickened and tender (Hoffa's disease).

Symptoms. Synovial membrane is very sensitive. The pain due to a nipped fringe is sudden and may be quite severe. Apparent 'locking' of the joint may occur owing to the pain which any movement may provoke.

The diagnosis is dependent on exact localization of the site of the pain during an attack.

Treatment. Although it is a simple matter to excise the offending fringe when exact localization is certain, the results are not always satisfactory. Often the joint is somewhat arthritic and the post-operative reaction and swelling may result in some other fringe being similarly affected.

Fibrous Adhesions

After any injury which causes bleeding, some of the extravasated blood may not be reabsorbed, especially if the affected part has to be

axis (inversion and eversion). Since during such movements the foot moves as a whole about the talus, movements at the subtalar joint are always associated with movements at the talo-navicular joint.

Unlike the ankle joint, this joint complex is unstable under load and is dependent upon muscle tone in order to maintain a balanced posture of the foot, the muscles chiefly concerned being tibialis posterior and peroneus longus.

Disabilities

Spasmodic Valgus

In this condition the foot becomes fixed in a position of eversion at the subtalar joint by persistent spasm of the peronei.

It occurs most frequently in adolescents who are on their feet all day in their first job after leaving school. It is also fairly common in army recruits. Physical strain must therefore be a factor in its aetiology. If this were the whole explanation the condition should settle down with a short period of rest, and this it entirely fails to do. Moreover, it is difficult to see why it should be only the peronei which go into spasm since they force the foot into a still further strained attitude.

This ridiculous condition which usually fails to respond to any form of treatment remains a mystery. An iron and T-strap is often necessary so long as pain is present, and sometimes it is necessary to arthrodese the subtalar joint in a corrected position. It is sometimes thought to be a hysterical manifestation and it is worth noting that in hysterical deformities of the foot it is invariably twisted into a position of inversion, not eversion.

Arthritis

The subtalar joint may become arthritic following injuries such as a fracture of the os calcis, and in rheumatoid disease. The results of arthrodesis of this joint are so good that it is nearly always the best answer for any disability of the joint whether it be the result of arthritis, deformity or paralysis.

symptoms are confined to the patello-femoral part of the joint and may then give lasting relief of pain.

Arthrodesis is the final resort, but a fixed knee is considerably more of a disability and inconvenience than a fixed hip. However, in cases where pain is intractable it is sometimes the only solution and the patient is usually well satisfied. The operation entails 8-10 weeks in hospital.

THE ANKLE

Mechanics

The ankle is a simple hinge joint, and owing to the bony mortise formed by the tibia and fibula, it is the only joint that is inherently stable when under load, even in the absence of muscle support. Its stability is, however, dependent upon the integrity of the interosseous tibio-fibular ligament. This ligament is sometimes torn in injuries to the ankle region when the foot is thrust laterally. The talus then impinges against the lateral malleolus and pushes it away from the tibia. This type of injury may lead to permanent instability of [illegible] on examination the [illegible] uently [illegible] when [illegible] sulting disability as an excuse to be 'boarded' out.

Disabilities

Since damage to the joint by fractures and dislocations is common, it is often the seat of osteoarthritic changes in later life. Although the joint may become progressively stiffer, it is usually painless until the arthritic changes are well advanced. Once pain does occur it is difficult to relieve by any conservative measures and arthrodesis of the joint may be desirable. This gives excellent results and causes very little disability, provided that the other joints of the foot are unaffected. The operation entails 2 weeks in hospital followed by 10-12 weeks in a walking plaster cast.

THE SUBTALAR JOINT

Mechanics

Although the movements which occur at this joint are rather complicated, for practical purposes the essential movement is that of rotation of the foot inwards or outwards about an antero-posterior

however, is a supple structure comprising a number of bones with movable joints between. Before it can be used as an active lever it must be rendered rigid, and the only practical way of effecting this in a segmented structure is to build it into the form of an arch. This is of course the meaning of the long arch of the foot. It is not, however, a fixed structure, for the normal foot is sufficiently mobile to be able to adopt a more or less flat-footed attitude when at rest, in addition to its fully arched posture of activity, though the extent to which it can do so varies considerably in different individuals.

The movements by which these different postures are brought about are complex, but may be considered as being essentially movements of rotation about an antero-posterior axis which occur at the two main joint complexes. These are:

1. The subtalar joint at which the foot as a whole is rotated about the talus into positions of eversion and inversion. During such movements minor adjustments occur at the talo-navicular and calcaneo-cuboid joints.

2. The mid-tarsal joints. At these joints the forefoot can be moved on the rest of the foot. Again the movement is essentially one of inversion and eversion. In addition, a small range of adduction and abduction is possible.

In order to change the posture of the foot from the resting flat-footed attitude to the fully arched position of activity, movements occur at these two joint complexes in opposite directions – the foot as a whole being inverted at the subtalar joint, while the forefoot is everted on the rest of the foot by an equal amount in order to keep it plantar grade. These two rotatory movements in opposite directions about an antero-posterior axis may be compared to that of wringing out a cloth. Thus in its active posture the foot has been literally screwed up, and so long as this screwed-up posture is maintained it is impossible to reduce the height of the long arch by applying a weight from above, for its various joints are securely locked. This change of posture from the resting to the active position is brought about by muscle action. Inversion of the foot as a whole is effected by the action of tibialis posterior assisted initially by tibialis anterior, while at the same time peroneus longus everts the forefoot on the rest of the foot to a similar extent in order to maintain it plantar grade. Their action may again be compared to that of one's hands when wringing out a cloth. Tibialis posterior and

CHAPTER V

THE FOOT

MECHANICS OF THE FOOT

The foot is essentially a propulsive machine based on the principle of the lever, though it also has to serve as a pedestal to stand on. The lever is formed by the foot itself, extending from the calcis to the metatarsal heads, while the latter form the fulcrum about which

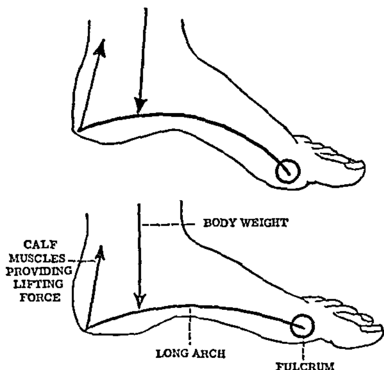


FIG 9
THE FOOT AS A LEVER

it moves (Fig. 9). To understand the mechanics of the foot it is necessary to consider these two components of the machine in some detail.

THE LEVER

The essential feature of a lever is that it shall be rigid. The foot,

however, is a supple structure comprising a number of bones with movable joints between. Before it can be used as an active lever it must be rendered rigid, and the only practical way of effecting this in a segmented structure is to build it into the form of an arch. This is of course the meaning of the long arch of the foot. It is not, however, a fixed structure, for the normal foot is sufficiently mobile to be able to adopt a more or less flat-footed attitude when at rest, in addition to its fully arched posture of activity, though the extent to which it can do so varies considerably in different individuals.

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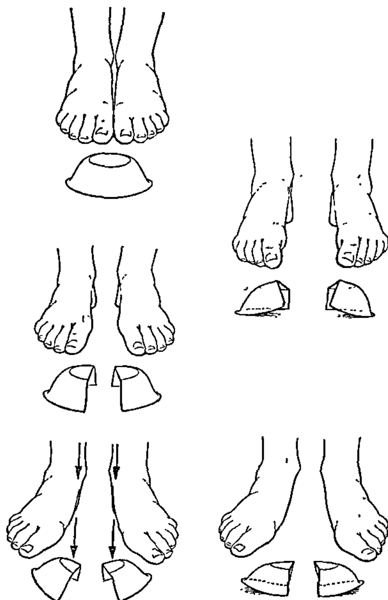


FIG 10
FEET AS DOMES

peroneus longus then maintain this active posture by their continued tone.

In this position the foot is in a state of balance, but if the tone of these supporting muscles relaxes it may easily move off balance. Now since the long arch is only present on the inner side of the foot, while its outer margin is in contact with the ground throughout, each foot resembles a half dome. When the feet are placed together they form a complete dome, which is a stable structure for the transmission of body weight. Once the feet are separated, however, the half domes which each comprises must have a liability to topple over inwards (Fig. 10). Thus when the tone of the supporting and balancing muscles relaxes the foot will tend to roll over inwards by a movement of eversion at the subtalar joint. The forefoot, however, will remain plantar grade and must therefore have become relatively inverted on the back part of the foot. The foot thus becomes unscrewed, the height of the long arch is lessened and since the foot has now rolled over on to its inner border and is off balance the weight will be transmitted as a shearing strain on to the ligamentous tissues along the inner border of the foot.

If one stands for any length of time in this relaxed 'flat-footed' or 'unscrewed' posture the strain on the ligamentous structures will be productive of pain, the condition being recognized by the term 'foot strain' – unless the joints of the foot are so mobile that the long arch itself can flatten completely without being rolled over. In this case the foot will rest flat on the ground, squarely under the leg, with no tension on any ligamentous structures, and will not therefore be subject to foot strain. Moreover, since there is nothing to support there will be no demands on the muscles and hence no liability to fatigue. A truly 'flat foot' that is also supple is therefore subject neither to pain nor fatigue, whereas a foot that has to some extent a fixed long arch demands constant support on the part of the controlling muscles if strain on its ligaments is to be avoided. On the other hand the foot that remains flat during activity cannot be used as a lever, but only as a portable pedestal.

The ideal foot is therefore one that can be built into a well-arched form and held rigidly in that posture during activity, but which can also relax completely so that it lies flat on the ground squarely under the leg when it is being used merely as a pedestal.

The average normal foot falls short of this ideal owing to the fact that it has to some extent a fixed long arch, which demands constant

support even when standing at rest, if ligamentous strain is to be avoided. It is therefore subject to fatigue and strain, though it is a very efficient machine for active propulsion.

It is necessary, therefore, to differentiate very clearly between the efficiency of a foot as a machine, its liability to pain and its shape.

Its efficiency is dependent upon good muscle control so that it is held securely in its arched form when under load. Freedom from pain depends primarily on its suppleness. The stiffer the foot the greater the likelihood of ligamentous structures being under tension. The shape of a foot is of secondary importance, though in general one can say that the highly arched foot is likely to be a stiff foot and therefore liable to foot strain.

Pes Planus

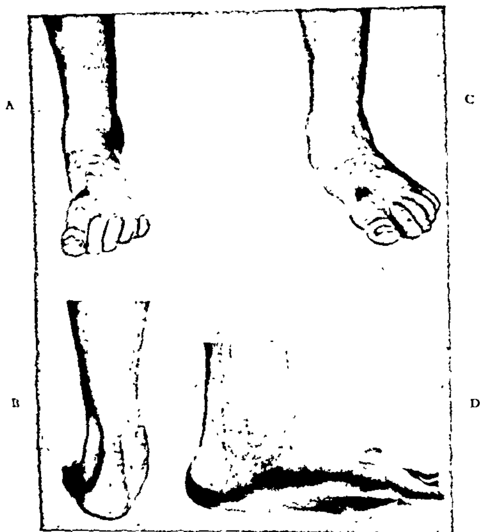
Pes planus, or flat foot, is a term used to describe the appearance of the foot when standing. The following are the common causes of such an appearance:

1. *Congenital*

This occurs in two forms:

(*a*) Structural. In such cases the talus may be deformed in shape, the head and neck of the bone pointing almost vertically downwards, while the rest of the foot is subluxed laterally in relation to it. In other cases a bony bar between the calcis and the talus or scaphoid prevents movements at the subtalar joint which is fixed in a position of eversion.

(*b*) Talipes calcaneo-varus. A supination or inversion twist of the forefoot relative to the rest of the foot is a component of several varieties of club foot. In the usually mild type known as talipes calcaneo varus, it is the only element of the deformity which persists, since the calcaneus or dorsiflexion element of the deformity is corrected spontaneously as the power of the calf muscles develops. The remaining deformity thus consists of an inversion of the forefoot, often combined with some degree of adduction (see Plate IA). When the foot is placed on the ground the inner border of the forefoot, i.e. the first metatarsal head, will fail to make contact. As weight is taken the foot as a whole will roll over inwards until the first metatarsal head meets the ground. Inversion of the forefoot thus imposes a corresponding degree of eversion on the rest of the foot producing an 'unscrewed' or flat-footed appearance (Plate IB). It



SUPINATION OF FOREFOOT

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should be noted that if it is not possible to bring the first metatarsal head to the ground in this way, or if the child is prevented from doing so by supports and wedges in the shoes, they will then actively fix the great toe in order to provide an alternative point for bearing weight under the pad of the toe. This throws a considerable strain on the great toe joint and leads to the early development of hallux rigidus (see p. 65 and Plate 10).

The persistence of a supination, or inversion, twist of the forefoot relative to the rest of the foot is therefore of considerable importance to the function of the foot, though its significance is not well recognized. It can most easily be recognized by the peculiar serpentine appearance it gives to the foot when standing.

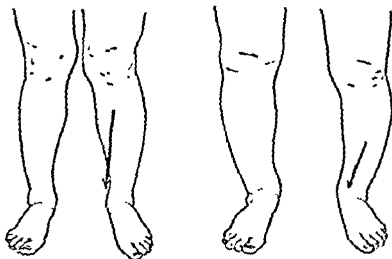


FIG 11

KNOCK KNEES AND BOW LEGS

2. *Infantile and Postural*

In most infants a pad of fat fills up the hollow under the long arch, which is thus obscured. Infants, therefore, have fat feet rather than flat feet. Further, until the child develops its postural reflexes the feet must adopt the relaxed flat-footed, or unscrewed, attitude when under load.

It may therefore be said that all infants appear to be flat footed, and that such an appearance is of no significance unless it persists unduly. If it should persist after the age of 3 or 4 years, and the feet themselves are of normal shape, some outside cause should be sought.

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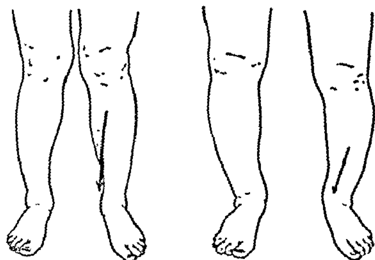


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The commonest causes are:

(*a*) Defective general posture (see Chapter 1).

(*b*) Knock knees and bow legs. Fig. 11 shows how both these conditions will throw the foot off balance into a flat-footed attitude.

(*c*) Short calf muscles. It would seem that muscles and bones often fail to grow at the same rate, so that at certain ages the tonal length of the muscles may be too short. This is especially noticeable in the hamstrings and calf muscles. If the calf muscles are tight it will not be possible to get the heel to the ground when standing unless the foot is everted at the subtalar joint, for eversion is accompanied by a small amount of dorsiflexion. Although a relative shortness of the calf muscles may be only transient, it sometimes persists into adult life. It is in fact one of the commonest causes of foot strain amongst army recruits.

3. *Paralytic*

Partial or complete paralysis of tibialis anterior and posterior is a not infrequent result of poliomyelitis. The unbalanced action of the peronei produces a severe valgus deformity of the foot.

4. *Spastic Flat Foot*

In this condition the foot is held rigidly in a position of eversion by spasm of the peronei. It occurs most commonly in adolescent males. Although occasionally some congenital anomaly such as a calcanio-navicular bar may be present, in most cases no cause can be found. Treatment is most disappointing, and usually the condition persists until the foot has become permanently stiff. It is this mysterious condition that produces the rigid flat foot of the adult.

5. *Pathological*

When any traumatic or arthritic condition causes stiffness of the subtalar joint the final position adopted is nearly always one of eversion, producing a rigid flat foot.

FOOT STRAIN

This term is used to define pain in the region of the long arch of the foot arising as a result of excessive or prolonged tension on ligamentous structures. As already stated, under normal conditions the ligaments play only an indirect part in resisting the force of

gravity, being protected from excessive strain by the tone of the supporting muscles. If for any reason this supporting action of the muscles fails, excessive strains will fall on the ligaments and pain will follow. Any of the conditions mentioned under 'Pes Planus' which throw the foot into a valgus and unbalanced attitude must be liable to produce symptoms of foot strain. This, however, only applies to the adult, for in children the tissues are so elastic that they can withstand almost unlimited strain without producing symptoms. Even in the adult the foot can accommodate itself to mechanical defects and faulty posture in a remarkable way provided that it is not subjected to any sudden change. Thus while mechanical and postural defects are predisposing causes of foot strain, the commonest inciting cause is muscle fatigue resulting from a change of occupation, some unusual activity, or muscle weakness following an illness.

Treatment

Acute Foot Strain. This almost invariably results from indulging in some unusual form of physical activity without an adequate period of training. There will be pain and tenderness along the medial border of the foot and under the long arch associated with tenderness and often some general swelling of the foot. The simple answer is to stop and start again more slowly. In severe cases a period of 24 to 48 hours' complete rest may save time in the long run. This is followed by a period of carefully graduated activity assisted by corrective exercises, while any predisposing cause is dealt with if possible. The condition is very common in convalescents who have been allowed to resume activities too rapidly and who have not been given exercises to the feet and legs while still recumbent.

Chronic Foot Strain. The first essential is to attempt to analyse the cause or causes of the symptoms, which may be mechanical, due to defects in the foot or elsewhere, or in the footwear, constitutional – for example a rapid increase in weight or a debilitating illness, or the result of the individual's activities – such as long periods of standing without adequate rest or exercise. Having dealt with any such predisposing factors, where possible, the following measures should be considered:

(i) Manipulation and Exercises. The stiffer the foot the more likely is it to develop symptoms of foot strain. Provided that there is no evidence of an inflammatory process being present, a gentle

manipulation moving all the joints of the foot briskly but not forcibly in all directions can do nothing but good. It should be followed by a course of mobilizing and corrective exercises (p. 101).

(ii) Arch Supports. Arch supports are a substitute for the normal supporting action of the muscles. Though often made of metal, supports moulded from compressed cork are lighter and more comfortable and are equally effective provided that the shank of the shoe is strong. They are useful for two purposes: 1. To relieve the strain on weak muscles, as in convalescence. In such cases remedial exercises should also be given to restore the muscles to normal tone, otherwise it may prove difficult to give up the supports. 2. As a permanent measure when it is clear that, owing to the condition of the feet or the age of the patient, normal function cannot be restored.

THE FULCRUM

The fulcrum about which the foot moves is formed by the five metatarsal heads. The metatarsal region of the foot exhibits two arches or curves. The one is the transverse arch of the foot, and the other is due to the extra length of the middle metatarsals, the metatarsal heads thus forming a curve convex forwards.

The transverse arch of the foot is, like the long arch, a functional rather than a structural entity, especially as regards its anterior part across the line of the metatarsal heads. When standing at rest this so-called arch is relaxed and *flat* which allows equal distribution of load on the metatarsal heads. When the heel is raised into the active 'take off' position there will be a tendency for the whole weight to fall on the middle metatarsals owing to their extra length. Normally, however, in this position the metatarsal heads are braced into an arched form, which has the effect of keeping the outer metatarsal heads firmly on the ground. If this bracing action of the muscles fails, or if the forefoot becomes splayed as a result of age or deformity, excessive weight will fall on the middle metatarsals and painful callosities will form under them.

Even under normal conditions, however, the area formed by the metatarsal heads is a very small one to take the full thrust of the body weight, and it is then that the action of the toes becomes important, for it is the primary function of the toes to press firmly on the ground with their pads so as to take some of the weight themselves and thus relieve the strain on the metatarsal heads. By this action they also give the foot a better grip on the ground and prevent its tendency to

skid backwards. Finally, by increasing or diminishing the pressure exerted by the outer and inner toes respectively they assist in maintaining balance when the heel is raised. This pressor action of the toes is carried out by a combined contraction of the long flexors and the interossei and lumbricals. Contraction of the long flexors alone would merely bring the tips of the nails to the ground, for their

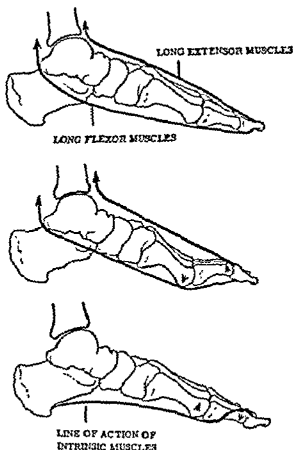


FIG 12

ACTION OF MUSCLES ON TOES

action is primarily to flex the interphalangeal joints. The interossei and lumbricals, however, maintain these joints in extension, thus transferring the flexor action of the long flexors to the metatarso-phalangeal joints. It should be noted that it is the action of the interossei and lumbricals combined with that of the adductor hallucis that is also responsible for bracing the transverse arch of the foot.

Effective toe action is therefore essential for maintaining the integrity and painless function of the forefoot (Fig. 12).

Anterior Foot Strain

This term is used to denote pain under the metatarsal heads due to excessive pressure. It is always associated with the formation of callosities under them, and it is always due primarily to a failure of the supporting action of the toes, which is itself due to a variety of causes:

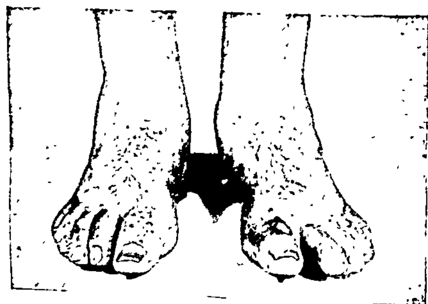
1. Badly fitting high-heeled shoes. High heels will clearly tend to pitch the weight on to the forefoot, which is the main reason why anterior foot strain is so much more common in women. In badly fitting shoes the foot will slide forwards until the toes are compressed into the toecap and prevented from functioning.
2. Painful lesions of the toes, such as corns. The muscles of the toes will never work if to do so would cause pain. Such pain is usually due to pressure or friction from a shoe which is too short or fits badly.
3. Hallux valgus deformities, which result in splaying of the forefoot and a consequent failure of the functional integrity of the transverse arch mechanism.
4. Paralysis, partial or complete, of the intrinsic muscles of the toes, which produces clawing of the toes as described below.

Claw Toes and Pes Cavus

Clawing of the toes is a progressive deformity due to weakness or paralysis of the interossei and lumbrical muscles. It is produced by the unopposed action of the long flexors and extensors. In the majority of cases a secondary cavus deformity of the foot develops. The mechanism by which this occurs is shown in Plate II.

The condition frequently develops during the course of the progressive nervous diseases, such as Friedreich's ataxia, and following partial lesions of the spinal cord or peripheral nerves. Sometimes,





CLAW TOES AND PES CAVUS

Above Before correction
Below After correction by interphalangeal arthrodesis

PLATE III



HALLUX VALGUS
Before and after correction by reconstructive procedure.



HAMMER TOE

Treatment

If there is no fixed deformity of the toes and the intrinsic muscles have recovered, an attempt should be made to restore function by special exercises (see p. 102). Sometimes a preliminary tenotomy of the tight extensor tendons may be helpful. Pain under the metatarsal heads can be alleviated by the provision of metatarsal supports (p. 115).

If these measures fail the condition can be dealt with by surgical means. Although the various methods of surgical correction all give good and permanent results, they do entail a long period of convalescence. The patient must be warned that it will mean approximately 8 weeks off work.

Hallux Valgus

Although 'hallux valgus' means simply a lateral deviation of the great toe, this term is used to include a multiple progression of deformities of the forefoot of which the deformity of the toe is the most obvious feature. It is always associated with some degree of varus deformity of the first metatarsal, the head of the bone becoming prominent on the inner border of the foot, giving rise to a frictional bursitis over it, known as a bunion. The deformity of the metatarsal leads to splaying of the forefoot so that symptoms of anterior foot strain are likely to develop with the formation of painful callosities under the second and third metatarsal heads. Finally, the great toe may force the second toe out of place so that it becomes dislocated dorsally at the metatarsophalangeal joint.

Aetiology

The precise aetiology of this crippling condition is not fully understood. There would appear to be two main factors which are chiefly responsible:

1. *Congenital Predisposition.* Two types of feet appear to be particularly prone to develop the deformity. In one the forefoot is broad and there is some medial angulation of the first metatarsal. This means that if the toe is straight it already makes an angle with its metatarsal so that the tendons are displaced laterally relative to the centre line of the joint. Their action will therefore tend to increase the angle between the toe and its metatarsal. The other type is the long, narrow, unstable foot that tends to collapse into a valgus attitude, producing lateral pressure on the inner side of the great toe.

The toe is often unduly long, which increases its tendency to be pushed laterally by the pressure of shoes.

2. *Footwear.* The condition is unknown as a cause of pain amongst races that do not wear shoes. It is also at least ten times more common in women, whose shoes with high heels and pointed toes would seem admirably designed for the purpose of producing the deformity.

Symptoms

Patients rarely seek advice unless the feet are painful, and it is for the relief of pain, rather than for the sake of appearance, that treatment is indicated. In early cases, and especially in children, much can be done by careful attention to footwear. In older people with established deformity, supports or specially made shoes will often suffice to alleviate pain. If these measures fail surgical treatment may be indicated.

Surgical Treatment

The surgical treatment of hallux valgus has a bad reputation amongst the general public and even amongst members of the medical profession, yet it can give results which are as gratifying as any in orthopaedic surgery. The condition is a serious and crippling one and must be treated as such. Bad results are nearly always attributable to choosing the wrong operation for the wrong case, or to lack of care in after-treatment. If the correct operation is done with due care one should not expect ever to see the patient again once the convalescent period is over – except perhaps to do the other foot.

There are four types of operation for this condition:

1. *Bunionectomy.* If the patient only complains of pain over the bunion it is tempting to advise a simple bunionectomy. Although this will temporarily relieve symptoms the result is usually short-lived and a year or so later the condition of the foot is worse than before. The patient's reaction then to the suggestion of corrective surgery is – I have already had one operation which wasn't any good, so what is the good of having another. Bunionectomy should never be undertaken except as a purely palliative procedure in the elderly.

2. *Arthroplasty.* This has been the standard procedure for well over a half-century. Excision of the head of the metatarsal or the base of the phalanx relaxes the soft parts sufficiently to allow the toe to be

corrected. Although either of these procedures gives reasonably satisfactory results as regards relief of pain in the great toe joint, they do not restore the integrity of the collapsed and splayed forefoot

first metatarsal as well as of the great toe and of restoring function to the various muscles controlling the forefoot mechanism. These operations are well worth while in the younger patient for they do give a stronger and better-shaped foot. Convalescence is, however, more prolonged and patients should be warned that it is likely to be 6 weeks at least before they can wear normal footwear. At the present time there is a growing tendency to advise a reconstructive procedure rather than a simple arthroplasty.

4. *Arthrodesis.* In some cases the surgeon may consider that the chances of achieving a good result by any of the above methods is doubtful, for example, when gross arthritic changes are present. Arthrodesis of the great toe joint then provides a suitable alternative. Although some patients complain of the inconvenience of having a fixed great toe joint, especially if they wish to wear high-heeled shoes, the majority are well satisfied, since they are relieved of pain and have a foot of reasonable shape. The operation entails 6 weeks in a walking plaster cast.

HALLUX RIGIDUS

Stiffness of the metatarsophalangeal joint of the great toe is due to the development of arthritic changes in the joint, which are the result of disease, such as gout or rheumatoid arthritis; injury, such as a heavy weight falling on the foot; or long continued strain from defective mechanics of the foot. The latter is by far the commonest and is the primary cause in the majority of those cases in which the condition is bilateral.

Normally, the stability of the foot when under load is dependent upon the capacity of the under-surface of the metatarsophalangeal joint of the great toe, i.e. the ball of the foot, to bear part of the load. It will fail to do so under two conditions:

1. If there is an inversion twist to the forefoot (see p. 56). In this case the inner border of the forefoot will fail to meet the ground unless the foot as a whole rolls over into a valgus posture.

2. If the first metatarsal is unstable like the first metacarpal in the hand. Such instability of the medial border of the forefoot will again tend to allow the whole foot to roll over into a valgus, or flat-footed attitude.

In both the conditions an attempt to stabilize the posture of the foot is likely to be made by active flexion of the great toe, so as to use the pad of the toe as an alternative point for weight bearing (Plate I). This effort to maintain the toe in flexion, while dorsiflexion is imposed upon it during each pace forwards, throws a severe strain on the metatarsophalangeal joint. As a result wear and tear changes soon begin to occur and the joint becomes progressively stiffer with the eventual production of a hallux rigidus. Indeed, the joint may have lost most of its range of movements by the age of 10.

Treatment

Preventive Measures. These can only apply in the case of children where there is stiffness of the great toe joints, but, as yet, no irreversible arthritic changes. It is unfortunate that the condition is so rarely noticed at this stage, unless the child looks flat footed. Treatment clearly must consist in removing the cause of strain on the joint by correcting the primary defect. When there is only a minor degree of instability supports and wedges in the shoes may suffice. In more severe cases surgical correction is indicated. This may entail metatarsal osteotomy to correct the deformity, or fixation of the metatarsocuneiform joint to restore stability.

Established Cases. Pain resulting from a stiff and arthritic great toe joint can often be relieved without recourse to surgery. If the pain is on the dorsal surface of the joint, due to impaction of the arthritic joint surfaces, a metatarsal bar fitted to the shoe will allow the foot to roll forwards without imposing dorsiflexion on the joint. On the other hand, pain underneath the joint, due to involvement of the sesamoid bones in the arthritic process, is best relieved by a combined long arch and metatarsal support which takes the pressure off the tender area.

If these measures fail, the condition can be dealt with by arthroplasty or arthrodesis of the joint. In the majority of cases arthrodesis is a safer alternative, as the patient has already got used to the stiffness of the joint.

CHAPTER VI

MINOR FOOT TROUBLES

The foot is prone to a wide variety of localized disabilities which are only minor in the sense that they rarely endanger life or limb, but they are liable to cause a disproportionate amount of pain and disablement. Although the treatment of such conditions should usually be the responsibility of the chiropodist or the orthopaedic surgeon, the patient's own doctor should be able to give advice as to how relief could be obtained and what it would be likely to entail.

The remarkable advances in present-day chiropody, in co-operation with the resources of orthopaedic surgery, and the assistance of surgical-shoe fitters have made it possible to keep even the most broken-down feet 'on the road' in reasonable comfort. For the efficient working of this team the patient's doctor should be able to act as 'umpire' and general adviser, for, apart from the local condition, so many other factors are involved both constitutional and environmental, and only he can see the whole picture. For example, the treatment of any particular condition may be markedly influenced by the patient's home or working conditions – or the fact that he has diabetes.

THE TOES

Ingrowing Toe Nails

The great toe is usually affected, most commonly on its lateral side. The symptoms may be due either to an involuted nail which is too highly curved from side to side, or to a hypertrophied fold of skin. In either case the edge of the nail burrows into the skin fold, and if the skin is broken sepsis may ensue.

The only safe home treatment is to pack the nail fold with lamb's wool to encourage the corner of the nail to grow out beyond the skin fold, and then to keep the nail trimmed square. This may be assisted by filing the central portion of the nail until it is thin enough [illegible]

When conservative measures fail the condition can be dealt with surgically, though this may mean a radical excision of nail and nail bed.

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If these measures fail, the condition can be dealt with by arthroplasty or arthrodesis of the joint. In the majority of cases arthrodesis is a safer alternative, as the patient has already got used to the stiffness of the joint.



In some cases a horny overgrowth of the nail occurs (onychogryphosis). Radical excision is the only final answer for this condition.

Hammer Toe (Plate III)

This differs from a claw toe in that the flexion deformity only affects the proximal interphalangeal joint, the terminal joint usually being hyper-extended. It usually affects a second toe that is unduly long. The chief complaint is of pain in the corn that develops over the prominent joint.

Relief of symptoms can be obtained by chiropodial measures. For this and many other minor deformities the chiropodist can fashion a semi-permanent protective appliance built up from felt, sponge rubber or cork and covered with a film of latex rubber, which can be slipped over the toe like a finger stall.

Alternatively the deformity can be corrected by arthrodesis of the joint in a corrected position. Like many minor foot operations this requires a precision of surgical technique that it is not always accorded.

Dislocated Second Toe

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the sole of the foot and a painful callosity forms under it.

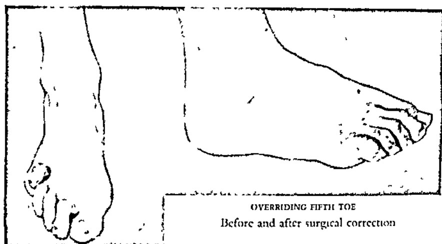
As the toe first begins to become displaced, an inflammatory capsulitis may develop which is presumably secondary to the stretching of the joint capsule. This should be taken as a warning and as an indication that correction of the hallux valgus should be undertaken as soon as possible. Once the toe has become dislocated it is impossible to replace it except surgically and this will entail removal of the base of the phalanx or the head of the metatarsal.

Over-riding Fifth Toe

This condition appears to have an hereditary basis. The toe has a varus deformity so that it rides on top of the fourth toe (Plate IV). As the deformity refuses to respond to any conservative measures, it is tempting to remove it. The absence of a fifth toe, however, may



PLATE IV

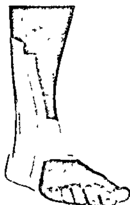


OVERRIDING FIFTH TOE

Before and after surgical correction



VARUS OUTER TOES



STRAPPING FOR A SPRAINED ANKLE

be productive of a quite considerable disability and its removal is inexcusable unless it has become infected, or its deformity is such that correction is impossible. In this case it can nearly always be corrected satisfactorily by a minor plastic operation.

Varus Outer Toes (Plate IV)

This is another familial condition. Usually the outer three toes are inclined medially, especially their tips, while the tip of the second toe may be inclined laterally so that it overlaps the third toe (Plate IV).

Deformities of the interphalangeal joints of the toes can only be corrected permanently by arthrodesis of the affected joints, and this is a practical impossibility in young children. This, therefore, is one of the few conditions that one prefers to leave as long as possible, preferably at least until the age of twelve years.

It is not worth while attempting to achieve correction by any lesser means.

METATARSAL REGION

Pain in the forefoot is most commonly due to the development of painful callosities under the metatarsal heads (see anterior foot strain, p. 62). There are, however, a number of other causes of pain in this region of which the following are the commonest:

Capsulitis

This may affect the metatarsophalangeal joint of the second toe only (p. 28) or the second, third and fourth together. Marked thickening occurs in and around the joint capsule which is extremely tender to pressure. Occasionally it heralds the onset of a generalized rheumatoid arthritis, but often no cause can be found.

Neurofibroma (Morton's Metatarsalgia)

This may cause severe pain which shoots into the toe or up the foot. Characteristically it affects feet that are otherwise normal, so that the patient may be considered to be neurotic. The only positive finding is a localized tender spot between and just distal to two metatarsal heads, usually the third and fourth.

The condition can be alleviated by a metatarsal support, but usually excision of the neurofibroma eventually proves necessary. This nearly always gives permanent relief.

Osteochondritis Dessicans

A similar condition to that which occurs in the knee and other joints (see p. 47) may also affect a metatarsal head, usually the second, during adolescence. The central portion of the articular surface suffers aseptic necrosis and becomes flattened while reactionary new bone forms around the margins of the articular surface producing marked thickening.

During the active stage a *metatarsal support will relieve pain.* Nothing further than this may be necessary but if symptoms persist indefinitely it may prove necessary to excise the affected metatarsal head.

March Fracture

This is a fatigue fracture which occurs in the shaft or neck of a metatarsal, nearly always the second. It is usually the result of some sudden increased activity such as a period of training for sports or the army. The patient complains of pain in the forefoot and there is considerable oedema on the dorsum of the foot. On palpation a tender spot will be found over the shaft of the metatarsal. A crack in the bone may be visualized on X-ray and later there may be much callus formation. In the past a diagnosis of bone sarcoma has been made on the X-ray [illegible].

Treatment consis[illegible] symptoms resolve spontaneous[illegible] be done to accelerate the process, though activities should be restricted to what can be undertaken without undue pain and swelling. The application of strapping around the metatarsal region of the foot may alleviate the symptoms.

THE HEEL REGION

Pain in the region of the heel may be due to a variety of causes. One of the following conditions will usually be found to be responsible.

Prominent Heels

In some people the upper part of the back of the calcis is unduly prominent. This causes friction between it and the back of the shoe giving rise to inflammation of the superficial calcaneal bursa. The condition most commonly affects adolescent girls and rarely gives rise to trouble in older women. The answer, therefore, is to

temporize by protective strapping when inflammation is present and by replacing the stiffening in the back of the shoe with chamois leather. Very occasionally, if these measures fail, it may be desirable to reshape the calcis surgically.

INFLAMMATION OF THE DEEP TENDO-ACHILLES BURSA

The Tendo-Achilles is inserted into the lower part of the back of the calcis, a bursa lying between it and the upper part of the bone. Inflammation of this bursa is due to an infective or 'rheumatic' condition and is not mechanical in origin. The swelling of the bursal sac fills up the hollows on either side of the Tendo-Achilles. Although the inflammatory reaction usually settles spontaneously, a course of physiotherapy will help to ease the symptoms, while an attempt, usually abortive, is made to discover the cause.

TENDINITIS OF THE TENDO-ACHILLES

This may occur in an acute form when it is really a tenosynovitis, and in a chronic form when the tendon itself is affected. A fusiform enlargement of the tendon develops which is very tender to pressure. It may persist for months but though it is resistant to all forms of treatment it eventually resolves.

It should not be forgotten that rupture of the Tendo-Achilles may occur with what may appear to be a trivial injury. The reactionary swelling may obscure the gap in the tendon, so that it is not infrequently overlooked.

CALCANEAL EPIPHYSITIS (Osgood's Disease)

This is a 'traction' epiphysitis similar to that which may affect the tibial tubercle. The epiphysis passes through the characteristic changes of aseptic necrosis, absorption and reformation. It does not result in any eventual disablement. During the active stage, however, it can be very painful. It most commonly affects boys of 10-14 years. The writer was afflicted by this condition. It was of course diagnosed as 'flat foot' and arch supports (i.e. valgus insoles) were prescribed. They were most helpful, presumably because they relieved some of the strain and weight on the heel. As they can do no harm they are well worth a trial.

OS TRIGONUM

The posterior lip of the articular surface of the talus sometimes

forms a separate ossicle, the os Trigonum. A sudden acute flexion strain of the ankle joint, as when one almost misses a step, may cause nipping of the soft tissues at the back of the joint. These symptoms are then liable to persist. An X-ray may reveal a separate os Trigonum which may be reported as a fracture. The patient then claims damages for a broken leg due to someone's negligence in allowing their steps to be slippery.

BRODIE'S ABSCESS

The body of the calcis is one of the situations where a chronic bone abscess may form, and it sometimes accounts for chronic pain in the heel for which no adequate cause can be found. An X-ray will reveal the characteristic cyst-like space in the bone surrounded by a thin layer of sclerosis. Surgical removal of the abscess nearly always results in complete cure with primary healing of the wound.

CALCANEAL FASCIITIS (see p. 27)

The above list is very far from being exhaustive, for it does not include a multitude of minor and often extremely painful and worrying afflictions, especially of the toes, which come more properly in the province of the chiropodist rather than the physician. This applies especially to the elderly, in whom it has been found by a number of surveys that the condition of their feet is the most important single factor in determining whether they can remain mobile and independent. There is a need for far more co-operation between physicians, orthopaedic surgeons and chiropodists in this increasingly important sphere of medicine.

CHAPTER VII

CARE OF CHILDREN'S FEET

Perhaps the most important consideration for those who are in any way responsible for the care of children's feet is to understand what conditions are possibly of serious significance and which can be left to look after themselves.

The following observations may be helpful:

1. In general, defects in the region of the long arch of the foot tend to resolve spontaneously as the child grows, whereas defects affecting the forefoot and toes tend to get worse.

2. Bow legs and knock knees in the younger child are rarely of serious significance. In most cases no treatment is necessary. When in doubt the provision of a ⅛-inch inside wedge to the heel of the shoes is a harmless measure which may be helpful and at least helps to reassure the parents that one is taking an interest.

The exception is the type of deformity mentioned on p. 11 which does require careful consideration.

3. The appearance of the foot is of far less importance than the range of movement present at the various joints, and its muscle control.

4. Deformities of the toes often require surgical correction. Some require correction at an early age, while others should be left until later. When in doubt expert advice should be sought.

5. Adequate care with footwear is far more important than any special treatment, as for example, by 'foot' exercises.

Special considerations apply at different ages:

In the Infant

Inspection of the infant's feet should of course be a routine practice in midwifery, but mere visual inspection is not enough. This will certainly reveal the classical club foot or Talipes equino-varus, but for other types of club foot, especially the calcaneo-varus variety, it is necessary to handle the foot and to inspect its range of movements. In Latin countries the mother is anxious to know whether the infant's hips are 'in', as congenital dislocation is so common, and woe

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betide the doctor who fails to make a correct diagnosis. In Britain they may be anxious about hare-lips and cleft palates. But few bother much about the infant's feet, unless they are obviously deformed.

The type of club foot that is usually overlooked is the calcaneo-varus variety, for the foot tends to lie in a plantar flexed position which masks the deformity. It is therefore necessary to examine the infant's foot in order to detect any abnormal range of movement. Once a number of normal feet have been handled, and not merely inspected, any variation from the normal will be readily detected.

During infancy the most important needs for the child's foot are freedom and warmth. Loose woollen socks are all the coverings they require. Decorative footwear, heavy bed-clothes, and shopping baskets in the pram are their main enemies. Mothers should be encouraged to handle their child's feet, which not only promotes activity but enables them to notice any abnormality. Infants should never be encouraged to stand or walk. The later they do so the better. In this respect children who are regarded as being physically backward usually show more sense than their anxious parents.

PRE-SCHOOL YEARS

Since young children so frequently appear to be flat footed, advice is constantly being sought with a view to remedial treatment. In fact, *provided* that the range of movements in the various joints is normal, treatment is rarely necessary. In these early years it is far more important to look after the welfare of their toes than of their feet.

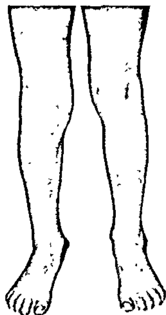
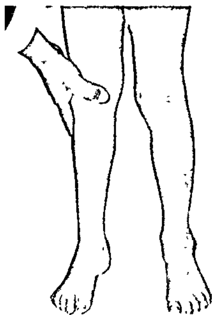
The essential consideration is to be sure that they have complete freedom to move. Although excellent shoes for children are available, they may fail either because they have not been properly fitted, or because they have been worn for too long. Sandals and house slippers are frequent offenders by having a toe-cap that is too rounded and too shallow. Shrunken socks, however, can be equally harmful.

The above may seem obvious, but children are frequently sent to orthopaedic clinics for '? flat feet', when in fact their feet are normal but their shoes and socks are a positive menace.

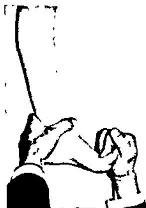
SCHOOL YEARS

Most children start their school life with normal feet. A high proportion finally leave school with well-marked foot disorders.

Plate V

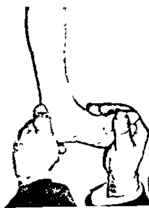
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FOOT INSPECTION

If half the attention were given to the care and maintenance of their feet that is given to their teeth a great deal of disablement in later life could be prevented.

This would entail regular foot inspections to detect abnormalities and deformities in their early stages, as well as infective conditions such as veruccae and fungus infections; to check their footwear; and to assess the results of any special measures previously adopted.

Foot Inspection

This should be carried out in the following manner:

The child is first examined standing, any abnormalities of the alignment of the toes being noted. If there is an appearance of flat footedness try to bring up the arch by rotating the knee outwards, while keeping it extended (Plate V(1)). Note whether this brings the ball of the foot off the ground. If it does, see whether it can be easily pressed on to the ground without rolling the arch over again. Any abnormalities of the legs or the general posture is noted at the same time.

The child is then examined sitting, the leg being held with the left hand (Plate V (2, 3 and 4)). The mobility of the joints of the foot and toes in all directions is tested first (especially the great toes). With the left hand holding the heel region squarely, the forefoot is inspected to see whether it has any inward twist, and if so whether this can be easily corrected.

The forefoot is then grasped and held squarely as shown and the foot flexed upwards. This will show the natural height of the long arch and will also reveal any tightness of the calf muscles. During this movement the foot must not be allowed to roll out into an everted or valgus position, as this would give a false impression.

Muscle power is then tested by making the child move its foot in all directions against resistance.

While this is being done the eye runs over the foot to check the condition of the nails, and for the presence of blisters, corns, plantar warts, etc.

Finally the shoes are checked for their general condition, evenness of wear, size and fit. Shoes should be at least two sizes longer than the foot.

All this can be done in less than a minute unless some defect is found that requires further examination.

Most of the early defects that would be brought to light by such

inspections would require no more than routine care with careful supervision of footwear. If cases were only referred to orthopaedic clinics when such measures had been tried and had not produced results, the specialist concerned would be more likely to take an interest. To have cases referred to him with, say, early hallux valgus in shoes two sizes too small is not productive of goodwill and a spirit of co-operation!

Adolescence

Even if the child finally leaves school with perfect feet, the girls then proceed to do their best to ruin them by going straight away into the most unsuitable 'fashion' shoes, with high heels and pointed toe-caps.

It would seem to be an excellent idea to explain to older girls at school the importance of good feet for the enjoyment of life, how to look after them, and how to choose the best shoes they can afford so that they can be both smart looking and comfortable.

The following good and bad features of shoes should be explained:

1. The higher the heel the more carefully should the shoe fit around the ankle and instep so that the foot does not slide down into the toe-cap.
2. For the same reason the heel platform should be as horizontal as the height of the heel will allow.
3. Court shoes are only held in place by close and accurate fitting of the upper rim. They therefore require the most accurate fitting of all types of shoe.
4. The shank of the shoe should be rigid, the flexibility of the shoe being in the line of the toe joints, and not across the middle of the shank.
5. The sole should be flat from side to side, and should remain flat in wear.
6. The uppers should fit accurately around heel and instep, but leave plenty of room for the toes.
7. If the shoe has a pointed toe-cap, this point must be beyond the end of the toes.

CHAPTER VIII

THE TREATMENT OF INJURIES

SIMPLE INJURIES

Damage sustained by any tissue in the body can only be repaired by the body's own healing processes. We cannot mend a broken bone or any other damaged structure – we can only aid or impede the natural healing process, and unless we understand these processes our efforts to help are more likely to be harmful than beneficial. In fact the final degree of disablement is often due more to the results of treatment than to the original injury itself.

If treatment is to be fully effective it must be based upon an understanding of the natural processes that occur during healing, and the stimuli which initiate and control them. We must also have a clear mental picture of the state of affairs inside the limb at all stages of the healing process. Fortunately, so far as fractures are concerned, recent work has given us a much clearer picture of bone repair, which enables us to define correct principles of treatment with far greater assurance.

For example, in the case of a simple fracture of the shaft of a long bone, immediately following the injury there will be an extravasation of blood between and around the fractured bone ends, followed by a reflex inflammatory reaction. This reaction is the direct result of the pain stimuli and is beneficial because it facilitates the mobilization of the forces of repair. The extravasated blood soon clots, and that part which lies around the bone ends, where the vascular supply is good and osteoblasts are set free by the tearing and lifting of the periosteum, is very rapidly organized into new bone, forming the so-called external callus. The new osteoid tissue thus formed, though as yet uncalcified, acts as a temporary splint preventing further pain, and thus allows the inflammatory reaction to settle down. The newly formed bone can then be calcified to form a more effective splint to the fracture, for calcification of bone cannot take place in the presence of inflammation. There is thus an automatic mechanism to provide a temporary splint which will then enable final union across the bone ends to proceed without disturbance.

Meanwhile the blood clot between the bone ends, where the blood

supply is not so good and few, if any, osteoblasts are present, is more slowly organized into fibrous tissue which contains islands of cartilage and tissue debris, mainly fragments of bone and muscle. What happens next depends upon a number of factors of which perhaps the most important is the type of mechanical stimulus to which the tissues are subjected. The main stimulus to bony union is a compression force applied to the bone ends. This is normally afforded by the tone of the muscles or by weight bearing. In the absence of this stimulus as, for example, when traction is applied to the limb, the process of final repair by bone may be completely inhibited. The fibrous tissue already formed then gradually becomes [illegible] grow out into this mass of fibrous tissue from both bone ends. They bring first fibroclasts and osteoclasts which absorb this fibrous tissue together with any imbedded tissue debris. Behind them come osteoblasts which commence to lay down trabeculae of new bone alongside the new blood vessels. Eventually these two advancing fronts meet across the gap, and provided they are not disturbed, will link up, thus restoring the continuity of the bone.

Thus it would appear that in the early stages of the repair process complete immobilization is not essential. It is only when the final link up across the gap is taking place that complete immobilization becomes necessary. In fact movements at the fracture site may even be beneficial in the early stages, for it will stimulate the formation of external callus. Such movements must not, however, be sufficient to cause displacement of the fractured surfaces, nor should they be permitted when the formation of excessive external callus might interfere with subsequent function, for example, when the break is close to a joint.

The fate of the surrounding soft parts in the limb is, however, of even greater importance than that of the bone itself so far as ultimate function is concerned. Immediately following the injury there will be an extravasation of blood into the tissues together with an exudation of tissue fluid due to the inflammatory reaction. If [illegible] loss of function which will be to some extent permanent – for once this fibrous tissue has formed it cannot be reabsorbed. The essential

consideration so far as the soft parts are concerned is, therefore, to ensure that all exudates are rapidly absorbed back into the circulation before they have had time to become organized. If this can be achieved then there will be no matrix in which new fibrous tissue can form and therefore no permanent stiffness can result.

The absorption of exudates is dependent upon the circulation and especially upon the rate and effectiveness of the venous return, which itself depends upon the degree of muscle activity that is going on in the limb. The most effective form of muscle activity is normal use for most of such actions are rhythmical in character, entailing a succession of contractions and relaxations by the muscles concerned which provides the best 'pumping' action on the circulation. Moreover, accustomed activities can be carried out for long periods without fatigue. If, owing to the demands of the fracture, normal use is impracticable, then special exercises should be given at frequent intervals, and they should be designed so as to bring as many muscles into play as possible. *It does not matter whether the muscle contractions effect any movement or not, for it is the compressing action of the contracting muscle on the venous system that is responsible for its effect on the circulation, not the movement which such contractions may cause.* Herein lies the fallacy of the term 'early movements'. Active movements are a convenient way of ensuring that muscles are being used, but it is not the movement which is beneficial but the muscle activity which causes it. Moreover, it is quite possible to exercise all the muscles in a limb without effecting any movements whatsoever.

If, therefore, we could ensure that all the muscles in a limb were actively used, and used repeatedly from the earliest possible moment after the receipt of the injury, then the circulation would rapidly be restored to normal, all exudates would be absorbed, no subsequent stiffness would ensue, and incidentally there would be no muscle wasting.

Indications for Treatment

The indications for treatment of the limb as a whole after the receipt of any injury are therefore: early activity so far as the needs of the damaged part will allow. The whole art of the treatment of injuries rests in finding the best compromise between the demands of the limb, and indeed of the body, as a whole, for a rapid return to activity, with those of the damaged part for rest and protection to allow healing to proceed.

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cause movement to occur at the fracture are stopped to allow final consolidation to occur. We must expect some stiffness, however, since such treatment falls far short of the ideal, for no exercises given to a limb in a Thomas's splint can compare with normal use so far as their effect on the circulation is concerned.

There is, however, another alternative, namely internal fixation of the fracture. If a splint could be applied directly to the bone which would hold it firmly enough to permit active use, all difficulties in ensuring effective treatment for the rest of the limb would be overcome. Internal fixation with plates, screws or other means is often regarded as being primarily used for the benefit of the fracture. With a few exceptions they are nothing of the *sort*. Internal fixation, which often involves a major operation, with its attendant risks, is rarely justifiable from the point of view of the fracture itself. Its great usefulness and main justification is that it enables effective treatment to be given to the rest of the limb. In order to do this it must hold the fracture sufficiently firmly to permit active use of the limb without the need for any external splint. The use of the Smith-Petersen nail for fractures of the neck of the femur is perhaps the most notable example of this method of treatment, for it not only allows full freedom of the limb, but it is also a life-saving measure in elderly patients.

An impressive example of the value of early activity in the treatment of fractures was afforded by Pott's fractures sustained during the training of paratroopers during the last war. With conventional methods of treatment in plaster the average period off duty was 33 weeks. A series of cases was then treated by immediate fixation of the fractured malleoli with screws. Full activity, apart from actual weight bearing, was then given for 3 weeks, or until the limb had returned to normal as regards muscle tone, mobility and absence of swelling. A walking plaster was then applied and retained until the fractures showed final consolidation. These cases returned to duty in 14 weeks on the average, the difference being almost entirely due to the fact that so little rehabilitation was required after the plaster was removed – they had had their rehabilitation before the fractures were united! In fact one day of active use in the early stages was worth a week's rehabilitation afterwards.

Exactly the same principles should apply to the treatment of 'soft part' injuries. If the damaged structure is to heal the torn ends must be brought together and then protected from disturbance until

In the case of a simple fracture these conflicting needs are not so difficult to reconcile as might be supposed. It has been shown that in the early stages of repair immobilization of the bone is not essential, so long as the fragments are not allowed to become displaced, while it is only during this early period that muscle activity is so important, for once all exudates have been absorbed, and the circulation and tone of the muscles has been restored to normal, the risk of subsequent stiffness and loss of function becomes negligible.

There are thus three stages in the treatment of a simple fracture.

First, reduction of the fracture and its immobilization by the application of a splint which should be the minimum necessary to maintain reduction and relieve pain.

Second, rehabilitation of the rest of the limb by active use, which should be accomplished within 2-3 weeks.

Third, complete immobilization of the fracture to allow final union to proceed without disturbance, though this should still permit as much active use of the limb as is practicable.

In many types of injury these ideals are quite easy to achieve. For example, in the case of injuries about the wrist, such as a Collé's fracture, effective immobilization can be ensured by the application of a plaster cast which leaves the fingers and thumb free, and permits of their active use in normal activities. Moreover, although the wrist itself is fixed, its flexor and extensor muscles will contract automatically whenever the fingers are moved, owing to reciprocal action. Thus all the muscles in the limb can be made to work and if in fact this is insisted upon from the earliest moment there need be no fear of subsequent stiffness.

In other cases, however, considerable difficulties may be encountered. For example, in the case of a fracture of the shaft of the femur it is impossible to maintain reduction and at the same time permit the patient to use the limb. Usually the treatment of the fracture itself involves the use of a Thomas's splint, and the application of traction to maintain length. It used to be taught that movements, especially of the knee, should only be permitted after 6 weeks, by which time new fibrous tissue would have been laid down binding all the tissues together and entailing months of after-treatment to restore any useful range of movements. Nowadays we start exercises at once and do not worry if movement occurs at the fracture site. After about 3 weeks, when muscle tone has been restored and all exudates have been absorbed, those exercises which

In most cases closure of the wound must be regarded as a calculated risk, in spite of antibiotics. It demands the most careful judgment based on wide experience, and if there is any doubt, the wound should be left open.

The treatment of an open wound involves the following stages:

1. *Wound toilet*. All dirt, foreign matter and badly damaged tissues are first removed. All skin should be preserved if it has the least chance of being viable. Generally there is a tendency to excise damaged or contaminated tissues too enthusiastically.

2. *Drainage and Immobilization*. In any reasonably well patient a protective barrier will be set up around the circumference of the wound which will prevent the spread of [illegible] (i) any discharge from [illegible] to build up press[illegible] that this barrier is not distu[illegible]

Perfect drainage is therefore the first essential, and complete immobilization the second. This is ensured by exploring the depths of the wound thoroughly and making new incisions for drainage if necessary, and then applying a splint which effectively immobilizes the whole of the affected area. A plaster cast is nearly always the best form of splint. If the above measures have been carried out properly no further measures are necessary until the next stage is reached.

3. *Secondary wound closure*. Although the plaster cast may be left on indefinitely the wound can only heal by the formation of granulation tissue, which is eventually transformed into fibrous tissue producing a massive scar. Moreover, epithelialization of the surface of the wound will not occur under a closed plaster cast. Once the danger of infection is over, therefore, the cast should be removed and the wound closed. The timing of this must vary in different cases, the usual time being 2-3 weeks after the receipt of the injury. Wound closure is carried out by secondary suture, or if there is too much skin loss, by skin grafting. Treatment of the damaged tissues then proceeds on the same lines as for simple injuries. Owing to the need for complete immobilization in the early stages it will not have been possible to promote the absorption of tissue exudates and extravasated blood, which are likely to have become organized into fibrous tissue. Some degree of stiffness is therefore unavoidable following compound injuries, except in those cases where primary closure has been possible.

healing has taken place. Any splint used for this purpose should, however, permit the maximum degree of activity of the rest of the limb. For example, in the case of a sprained ankle where the lateral ligament is torn, strapping may be applied in such a way as to prevent inversion movements. But it should leave all other movements free, and must not impede the circulation. The leg should then be used just as soon as pain and swelling will permit.

In some injuries, such as tendon ruptures, the torn ends retract and natural repair is impossible. In such cases, with a few special exceptions, an immediate return to activity is the answer, the damaged structures being repaired later if necessary, after the functions of the rest of the limb have been restored to normal.

To sum up, the treatment of all simple injuries should be based upon the following principles:

1. *Reduction*, to ensure that the damaged parts are brought into close and accurate apposition.
2. *Rehabilitation of the limb* by promoting the maximum degree of muscle activity consistent with the maintenance of reduction.
3. *Immobilization of the damaged parts*, after the rest of the limb has been restored to normal and all exudates have been absorbed.
4. When the conflicting demands of the limb as a whole and of the damaged part cannot be reconciled, the best compromise has to be selected, and herein lies the art of the treatment of injuries.

COMPOUND INJURIES

The presence of an open wound which may become infected is the most important factor to consider in the treatment of all compound injuries and must take precedence over all other considerations. It is, however, highly desirable to convert a compound into a simple injury by closure of the wound if it is considered that the risk of sepsis is sufficiently slight. The conditions under which such a procedure may be considered are:

1. When the wound is compound from within or is a clean incised wound.
2. When there is no obvious contamination of the exposed tissues.
3. When the closure can be carried out within 6 hours of the receipt of the injury.
4. When the advantages to be obtained by closure are such that some risk is worth taking, as for example in joint injuries.

In most cases closure of the wound must be regarded as a calculated risk, in spite of antibiotics. It demands the most careful judgment based on wide experience, and if there is any doubt, the wound should be left open.

The treatment of an open wound involves the following stages:

1. *Wound toilet.* All dirt, foreign matter and badly damaged tissues are first removed. All skin should be preserved if it has the least chance of being viable. Generally there is a tendency to excise damaged or contaminated tissues too enthusiastically.

2. *Drainage and Immobilization.* In any reasonably well patient a protective barrier will be set up around the circumference of the wound which will prevent the spread of any infection provided: (i) any discharge from the wound can escape freely and is not allowed to build up pressure in the depths of the wound, and (ii) that this barrier is not disturbed by movement.

Perfect drainage is therefore the first essential, and complete immobilization the second. This is ensured by exploring the depths of the wound thoroughly and making new incisions for drainage if necessary, and then applying a splint which effectively immobilizes the whole of the affected area. A plaster cast is nearly always the best form of splint. If the above measures have been carried out properly no further measures are necessary until the next stage is reached.

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NERVE AND TENDON INJURIES

When nerves or tendons have been severed the difficult decision has to be taken whether to attempt immediate suture or to leave them to be dealt with later. Although immediate suture is always a tempting proposition and is sometimes justified there are strong arguments against it:

1. The repair will be in plane of the wound. As the wound heals by the formation of fibrous tissue all the affected structures are likely to become adherent in this plane from the skin downwards. In a late secondary suture the incision can be planned so that it is not in line with the nerve or tendon repair.

2. Since the fibres of nerves and tendons are all longitudinal and only loosely bound together, sutures tend to cut out easily. A few weeks later new fibrous tissue will have formed in the cut ends which greatly facilitates repair.

3. Immediate suture also entails closure of the wound and may tempt one to close a wound that should have been left open.

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CHAPTER IX

INFECTIVE ARTHRITIS AND OSTEOMYELITIS

Although the advent of antibiotics revolutionized the results of the treatment of infective conditions, the principles of treatment remain the same as before. These are:

1. To provide rest and immobilization to the affected parts. Immobilization applies to muscles as well as joints in order that the natural protection barrier which is formed around the infected area is not broken by their contractions.
2. To evacuate any collection of pus that may form.
3. To provide drainage if there is any risk of further collections forming. In the case of joints drainage of the actual joint cavity should be avoided if possible, owing to the risk of subsequent stiffness that this entails. If pus forms in the joint it can usually be dealt with by aspiration, after the initial evacuation.

With the use of antibiotics in pyogenic infections the formation of an abscess can usually be avoided and surgical intervention is thus often unnecessary. This great advance in treatment has, however, produced its own problems:

1. *Should antibiotics be given immediately if an acute pyogenic infection is suspected?*

It is a good general rule in medicine not to commence such treatment as will mask symptoms until an accurate diagnosis has been made. Antibiotic treatment, if effective, will certainly mask the symptoms and may also render the subsequent identification of the organism impossible. Moreover, it may result in an abscess being overlooked. If one waits, however, the chance of arresting the disease before any tissue destruction has occurred, or an abscess formed, may be lost. The decision is therefore often a difficult one.

As a general guide it may be said that if the infection is not too acute and the patient can be admitted to hospital immediately, it is best to wait. On the other hand, in the case of a fulminating infection in a patient who is already showing signs of toxaemia any delay should be avoided.

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3. Immediate suture also entails closure of the wound and may tempt one to close a wound that should have been left open.

4. If suture has been carried out, more rigorous immobilization is required which will prevent early activity and thus lead to a greater degree of eventual stiffness. If suture is delayed, 'rehabilitation' of the limb can be carried out first. There will then be much less risk of trouble following the later clean and planned operation.

In spite of these [illegible] in a clean incised [illegible] retraction of the [illegible] anchoring stitch to prevent retraction is the best answer, final repair being carried out later.

2. An acute pyogenic infection of the upper femoral epiphysis sometimes occurs in infants (Smith's epiphysitis). The infection rapidly spreads into the hip joint and may cause complete destruction of the head of the femur. Fortunately it is now much less common but the possibility should be borne in mind if an infant suddenly starts to scream when one *hip* is moved, since immediate treatment offers the only hope of saving the joint.

3. An infective arthritis of the hip sometimes develops during the course of one of the childish fevers, especially scarlet fever. Unfortunately pain is not a marked feature, and it may therefore be overlooked until a pathological dislocation of the hip has occurred. It should be a routine to examine a child's hips daily during the course of the fever. This can easily be done as part of the routine of its daily toilet.

TUBERCULOSIS

Tuberculous infection of bones and joints is becoming much less common, and its treatment must in any case be the responsibility of the specialist. Early diagnosis is, however, extremely important if the best results of treatment are to be achieved.

In many cases the usual signs of a low-grade inflammatory process are present and a tentative diagnosis can be made without difficulty. Often, however, the condition does its best to delude the physician by playing unfair tricks, of which the following are worth bearing in mind:

1. There may be a clear history of an initial injury, such as a sprain, followed by pain and swelling, which, however, does not completely resolve. The joint continues to swell slightly after activity but there are no other signs of an inflammatory process. The clue lies in the disproportion between the trivial nature of the injury and the degree of subsequent reaction.

2. There is again a history suggestive of a sprain, which completely recovered, but the joint suffered further 'sprains' without there being any adequate cause. Repeated 'sprains' without evidence of mechanical weakness, such as a lax or ruptured ligament, should excite one's suspicions.

3. Recurrent effusions into a joint, or generalized swelling may be due to a variety of conditions such as hypertrophic synovitis, capsulitis and rheumatoid arthritis, but tuberculosis may try to disguise itself as any one of these.

If it is decided to start treatment immediately, then a massive dose should be given. Half-hearted measures are worse than none.

2. *How can one tell whether an abscess has formed?*

This again may be difficult during the course of antibiotic treatment, since the usual signs may be absent. The persistence of localized tenderness and induration after the general symptoms have subsided is the most reliable sign, especially if the patient remains pyrexial. It is thus necessary to examine the affected part repeatedly, as pain may not be present. For this reason a closed plaster cast should not be used.

3. *When should one stop treatment?*

The outward signs of an infection may subside very rapidly under antibiotics so that one is tempted to stop treatment too soon. A careful watch should be kept on the blood picture and the sedimentation rate, as these are more accurate guides than the apparent condition of the patient. A good rule is to note the time taken for the signs of an infection, such as pain, pyrexia and toxaemia, to subside, and then continue antibiotics for an equal period afterwards.

In osteomyelitis bone changes continue long after the infection is over, and in certain long bones, especially the humerus, they may look alarming on X-ray. There is sometimes a massive periosteal reaction down the whole shaft of the bone which may show progressive changes over the course of several weeks. Such reactions are as a rule of little significance.

Certain infective conditions that affect children deserve special mention since they first come into the hands of the general physician rather than the specialist and their early recognition is most important:

1. *Inflammator* [illegible] as tonsillitis or quin[illegible] [illegible]ent spinal ligaments, [illegible] on the axis. As a result the atlas may slip forwards away from the odontoid process which then presses on the spinal medulla. This may cause sudden death. Any suggestion of neck stiffness, or that a child is holding its head in a forward flexed position following a pharyngeal infection, should be treated with the utmost respect and the child immediately put back to bed.

2. An acute pyogenic infection of the upper femoral epiphysis sometimes occurs in infants (Smith's epiphysitis). The infection rapidly spreads into the hip joint and may cause complete destruction of the head of the femur. Fortunately it is now much less common but the possibility should be borne in mind if an infant suddenly starts to scream when one hip is moved, since immediate treatment offers the only hope of saving the joint.

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3. Recurrent effusions into a joint, or generalized swelling may be due to a variety of conditions such as hypertrophic synovitis, capsulitis and rheumatoid arthritis, but tuberculosis may try to disguise itself as any one of these.

In cases of doubt one should have an X-ray taken of the affected joint, and of the chest. Also a blood sedimentation rate.

TREATMENT

The combination of the usual constitutional measures combined with antibiotic therapy and the surgical extirpation of the diseased area offers an excellent prognosis in nearly all cases. The general public, however, still regard a diagnosis of 'T.B.' with horror, alarm and despondency. Often they still prefer to hide their suspicions in case they should be correct, and if the diagnosis is confirmed to regard it as a sentence to crippledom or worse. It is now the role of the medical practitioner to dispel these misconceptions, even to the point of exaggerating a little the other way, by telling the patient, for example, that it is lucky it turned out to be T.B. as that is a condition that can be cured. This is important, for the final result in all conditions that require prolonged treatment depends so much on the patient's morale and mental outlook.

CHAPTER X

PARALYSIS

CEREBRAL PALSY

(Little's disease, Spastic Paralysis)

Various types of cerebral defect occur in infants as a result of birth injuries, developmental defects, or, occasionally, infective conditions such as encephalitis. As the lesions are in the cerebral cortex or basal ganglia the effects are of the upper motor neurone type. They fall into four main groups:

1. Spastic. The muscles are in a state of hypertonicity, the affected limbs being held stiffly and moved with difficulty. The tendon reflexes are increased, the plantar responses being extensor. The lower limbs are usually affected most, especially the antigravity muscles and the adductors of the hips. This tends to produce a 'scissors' gait, with extended knees and equinus deformity of the feet.
2. Athetoid. Involuntary and purposeless movements are carried out, especially by the arms. The movements become worse when an attempt is made to control them unless the limb is held rigid, which gives an impression of spasticity.
3. Ataxic. These are much less common but are occasionally encountered, being due to a cerebellar defect.
4. Mental defect. This may be slight or severe, and is often difficult to assess owing to the associated physical defects.

The 'spastic' type is by far the commonest and it is also the variety that occurs in the mildest forms. The effects may be confined to one leg, one-half of the body, or occasionally all four limbs. Diagnosis only presents difficulties when the effects are slight. In such cases the main points to look for are – difficulty in dorsiflexing the foot, an extensor plantar response, a stiff feeling when moving the knee passively, and limitation of abduction of the hips. In the arm there will be some difficulty in extending the fingers and abducting the thumb. The elbow is usually held flexed and the shoulder adducted.

TREATMENT

This is primarily a matter of education, especially to teach the

power to carry out voluntary relaxation of the affected muscles. Surgical measures are indicated for the relief of persistent deformity and contracture, but they should only be undertaken after the most careful assessment of all the factors involved, especially as they may cause a serious setback to the result of months of careful re-educational measures.

They comprise such measures as tendon lengthening, often combined with the incision of joint capsules to overcome contractures, the partial division of motor nerves to reduce spasticity in certain muscle groups, and arthrodesis of joints in the best functional position when they cannot be controlled voluntarily and persistently adopt a position of deformity.

ANTERIOR POLIOMYELITIS

This is an infectious disease caused by a virus which has a special predilection for the anterior horn cells in the spinal cord, and sometimes those in the basal ganglia. The disease itself is of short duration and though it may be severe it is often passed off as an attack of influenza, which the clinical picture closely resembles. A fatal result is more common in the adult when it is usually due to respiratory paralysis. Paralysis usually becomes apparent during the early stages of the disease, though its onset may be delayed for several days.

After the initial attack there is a phase of recovery lasting several months, the extent of recovery depending primarily upon the extent of the damage sustained by the anterior horn cells. Finally, a stage is reached when no further recovery can be expected, provided that treatment during the recovery stage has been efficient. Late so-called 'cures' are entirely due to remedying defects in previous treatment when the maximum use of residual muscle power has not been achieved.

TREATMENT

During the initial phase bed rest is the prime essential. Limbs affected by paralysis should be supported in a comfortable relaxed position. Hot packs may be used to relieve pain. As soon as the symptoms have subsided and the muscles are no longer painful,

active measures are begun. These consist of active and passive assisted movements to all joints and muscles, the limbs being supported, but not immobilized, in the intervals between. The degree of activity should be that which the particular muscles can carry out without undue effort or fatigue. This determines when the patient can be allowed out of bed, extra support being then given when necessary. Since the spine is the most difficult part to support adequately, recumbency is necessary for a much longer period when the trunk muscles are affected. All treatment should be carried out when the parts are warm. Light massage may be used to assist the circulation.

SPLINTS

During the initial stage the body and limbs require to be supported in a relaxed and comfortable position. For this purpose a bed with a suitable arrangement of pillows is the best splint. Occasionally extra support may be indicated to prevent deformities arising as a result of unequal paralysis of different muscle groups, for example, a cock-up splint for paralysis of the extensors of the wrist, or a plaster slab gutter splint to prevent a drop-foot deformity.

When the patient becomes ambulant, more elaborate means of counteracting the force of gravity may become necessary. The three most commonly used appliances are: some form of spinal brace, walking calipers, and below-knee irons with ankle straps and when necessary a toe-raising spring.

When no further recovery is possible a general assessment of any residual paralysis must be made to determine whether any further improvement in function can be achieved by surgical means.

These may comprise tendon transplantations to restore muscle balance, joint stabilization by arthrodesis, and correction of deformities, if they have been allowed to occur, by capsulotomy, tendon lengthening and occasionally osteotomy.

The following examples illustrate some of the possibilities:

Paralysis of the biceps and brachialis muscles affected the right arm of a commercial traveller. When he attempted to shake hands his arm tended to drop before his hand was grasped, causing him much embarrassment. The origin of his forearm extensor muscles was transplanted higher up his humerus, so that they could act as flexors of the elbow as well. This enabled *him to hold out his hand* maintaining the elbow flexed, and so to retain his job.

A young engineer developed paralysis of the extensors of the right wrist, fingers and thumb and could not carry on his career. The wrist was arthrodesed in slight dorsiflexion. The flexor carpi radialis and ulnaris, which were now going spare, were transplanted into the extensors of his thumb and fingers respectively, with the result that he could return to his original work.

A young woman of seventeen had a completely paralysed right leg, apart from some power in the hamstrings which had caused a flexion contracture of the knee. The leg was 3½ inches short and she had never walked on it since the age of 3, having always used crutches.

She agreed to a formidable surgical programme which included arthrodesis of the hip, correction of the flexion contracture of the knee, stabilization of the foot, lengthening of the femur and shortening the opposite one. She was eventually able to walk without sticks and only a slight limp and she married and brought up a family.

PERIPHERAL NERVE INJURIES

The peripheral nerves consist of a bundle of axons, which are the conducting filaments, each surrounded by an insulating layer, the myelin sheath, which is itself covered with a fibrous sheath, the neurilemma. Its functions may be affected in three ways:

1. *By Pressure*

The first effect of pressure is an interruption of the blood supply to the nerve, which very soon renders it unable to function. This causes complete temporary loss of both motor power and sensation which, however, quickly recovers as soon as the pressure is released. This is the cause of the familiar phenomenon of a limb 'going dead' when held for some time in an awkward position.

If the pressure on the nerve is more severe, the soft insulating myelin sheath is squeezed away. Impulses passing along the axons then 'short circuit' and fail to reach their terminals. Since the motor fibres are the largest they are the most susceptible to pressure and are affected first, then touch, deep sensation and finally pain, though as the last are so small they are rarely affected.

Tourniquet paralysis, in which the paralytic effect is almost entirely motor, is a good example of this type of damage, which is known as neurapraxia. The myelin sheath is repaired fairly quickly once the pressure is released, and since the axons and the neuri-

lemma are not affected, complete recovery occurs in a matter of a few days, or at the most a few weeks.

2. *Crushing Injuries*

In this type of injury both the myelin sheath and the axons are damaged or destroyed over a section of the nerve. Its continuity is, however, preserved by the fibrous sheaths. When an axon is damaged its distal part degenerates and is absorbed. The proximal end, however, almost immediately starts to grow. Since it is still enclosed within the tube formed by its neurilemma sheath it can only grow down it and eventually reach its original end organ. Thus again complete recovery can occur, though it takes much longer as an axon grows at the rate of about 1 mm. a day. This type of damage is called axonoptmesis.

3. *Complete Division or Neuroptmesis*

When a nerve is cut across, all the axons start to grow out from the proximal cut end and try to find a neurilemma tube to grow down. There is a free-for-all contest to find the distal cut end of the nerve, which comprises a bundle of neurilemma tubes from which the contents are being absorbed. Each axon has, therefore, first to find the cut end of the nerve and then to find a vacant sheath of suitable size. Unless the two ends are in accurate apposition its chances of finding its original sheath are negligible, and even then it is just as likely to find an adjacent one. Thus a motor axon which has jubilantly defeated its rivals and found a vacant tube may arrive at the end of its long journey in a touch corpuscle, while late starters may fail to find an unoccupied tube and then wander aimlessly about, the outward sign of their frustration being the 'terminal neuroma'.

Thus complete recovery of function after nerve division is not a practical possibility, though good function may be restored if only a comparatively small proportion of the axons eventually arrive at a suitable destination.

Since the distal empty sheaths tend gradually to contract there is a definite time limit before the regenerating axon finds its further progress impeded and becomes strangulated.

The regeneration of a cut nerve is therefore a rather tragic epic of frustration but it is easy to see that the degree of ultimate recovery must depend on: the accuracy of apposition of the cut ends, the time

when this is achieved, the distance the regenerating axons have to cover, and finally the variety of different axons that the nerve comprises, for it is clear that in a purely motor nerve the chances of good recovery must be much better than in the case of a nerve that carries both motor and a variety of sensory fibres.

It should also be clear that although a good return of muscle power may be achieved, the action of individual muscles as opposed to group muscle activity is bound to be deficient, for the motor axons are certain to be hopelessly mixed up. Thus while good power of flexion and extension of the fingers may be regained, it is likely to be impossible to flex or extend any individual finger by itself.

TREATMENT

If a nerve is severed by a clean incised wound, the cut ends should be accurately sutured together. The pros and cons of early or late suture were considered in Chapter VIII. If a section of the nerve has been completely destroyed it may be possible to bring the ends together by a fairly extensive mobilization of the nerve trunks both proximal and distal to the site of damage. If this is not feasible the gap may be bridged by a nerve graft.

The most difficult cases are those where the damage has been caused by a severe stretching of the nerve. In this case the individual fibres may have given way at different levels and it is often impossible to assess the degree or extent of the damage by inspection of the nerve. Surgical interference is then more likely to do harm than good.

Muscles that have lost their nerve supply will show signs of wasting and degeneration. While waiting for the nerve to recover they can be exercised by galvanic stimulation and their circulation maintained by exercising adjoining muscles and by massage. Unfortunately it is not economically possible to give such treatment sufficiently frequently or for long enough periods for it to be really effective. It is even more important to prevent stiffness of any affected joints, by passive movements, if active movements are not possible, and to keep a watch for contractures which may develop as a result of unequal muscle tone. This is the main indication for splinting. In the past such splinting has been used too rigorously and has caused much avoidable stiffness. The use of splints should carry with it the obligation to remove them at least twice daily, so that active treatment to obviate stiffness can be given. Such treatment should comprise active and passive movements of all the joints of

the limb combined with preliminary heat and massage, together with galvanic stimulation of affected muscles if this is considered to be desirable.

OTHER TYPES OF PARALYSIS

Various other types of paralysis may cause interference with the functions of the locomotor apparatus. The most important are the muscular dystrophies, Friedreich's ataxia and spina bifida. In all these conditions the most serious disturbance of function is in the legs, and in all, the muscles most affected are the peronei and the intrinsic muscles of the toes. This results in a progressive varus deformity of the feet associated with pes cavus and clawing of the toes. In spina bifida the cauda equina may be adherent to the overlying tissues opposite the defect in the spine, which is usually in the lumbosacral region. During growth the spinal cord gradually recedes up the spinal canal as it does not grow as fast as the spine. This causes a stretch palsy affecting the adherent parts of the cauda equina. Although there may be no obvious signs of such a defect being present, it is often indicated by some local abnormality such as a pigmented patch or a local growth of hair. Paralytic symptoms are usually first noticed around the age of 10 years.

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CHAPTER XI

PHYSIOTHERAPY

Physiotherapy means treatment by physical as opposed to chemical means. While most physicians take great care in the exact prescription of medicines, when it comes to physiotherapy their prescriptions and their thinking tends to stop abruptly at the terms 'heat and massage', or perhaps 'heat, massage and exercises'. If the physician were to go no further than this with his medical therapy his prescriptions might read 'drugs for (say) indigestion in a bottle with a cork'. Yet the rationale of physical means of treatment and its indications is much easier to understand than any other form of treatment.

It must be admitted, however, that the advances of science are beginning to make even physiotherapy more complicated and difficult. No doubt in due course it will become a 'boffin' land inaccessible to the ordinary doctor. It is still possible, however, to define the rationale of the more well-established and basic forms of physical therapy, which is all that need be considered in this chapter.

MASSAGE

Massage is more misused, abused and maligned than any other form of physical treatment. It can be usefully employed for three purposes:

1. Light effleurage. Light stroking movements act physiologically to relieve spasm and tenseness in muscles and psychologically to induce a feeling of confidence and relaxation.

2. Firm massage applied centripetally assists the venous return when the circulation is sluggish and thereby assists in the absorption of exudates in the tissues. It has a further and perhaps more important use. Tissue exudates are liable to clot and then to be organized into fibrous tissue. If this happens in the neighbourhood of joints, some degree of permanent stiffness may follow. If such exudates can be dispersed into the near-by muscles, not only will they be potentially much less dangerous, but they will also be far more easily absorbed back into the circulation.

3. Deep massage and deep friction. This is useful for localized

inflammatory lesions such as 'tennis elbow'. It is difficult to understand exactly why it should be effective, and the results certainly vary considerably with the skill of the operator. It has been suggested with some ribaldry that its effect is comparable to that of the lunatic who kept banging his head against the wall because it was so nice when he stopped.

HEAT

Heat promotes vasodilation and by this means it assists in the absorption of inflammatory exudates and also in mobilizing the body's defensive and reparative processes.

It can be applied externally in the form of radiant or infra-red rays, hot wax or fomentations (a much neglected art), or by engendering heat in the tissues themselves by diathermy. The latter is the most effective, especially in acute inflammatory lesions, but it is contraindicated if the inflammatory process affects nerves, or in some cases bone. In such cases the congestive effect may increase the pain to an intolerable extent. The bony lesions that may be adversely affected are the affections associated with sclerosis of bone, such as Paget's disease and chronic osteomyelitis.

Hot fomentations are such a simple remedy that they are out of favour, but they can be most effective when correctly used. Moreover, they do not necessitate referring the patient for hospital treatment.

They are most useful in assisting the resolution of a local inflammatory lesion of infective origin. Four layers of lint of adequate size are rolled up in a face towel. The middle portion of the roll containing the lint is dipped in boiling water, while holding the two ends. It is then looped over a tap and wrung out *dry*. The *dry* but steaming lint is picked out, applied to the part and covered with a cotton-wool dressing. It is left on for not more than 20 minutes, the process being repeated 2 hourly for 8 hours. After that no further benefit can be expected. This may seem like teaching one's grandmother, etc., but few of the younger generation know how to make use of this safe and simple home remedy.

EXERCISES

Special exercises can usefully be employed for four purposes:

1. To assist in restoring strength to individual muscles, or to

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opposite side when standing on one leg. In order to do this it uses its 'insertion' into the great trochanter as the fixed point, which is thus functionally its origin.

3. In order to restore full function to a muscle it should therefore be made to work in both directions. It should also be given the chance to carry out its functional 'holding' activities as well as that of promoting movements.

4. Muscles are only used economically when performing some natural and habitual action. Direct conscious control of their activities is always relatively inefficient and productive of fatigue. For example, if one dorsiflexes one's ankle fifty times one will experience a definite feeling of fatigue in the anterior tibial muscles. Yet when walking a mile this action is carried out 1000 times with no feeling of fatigue.

This has an important bearing on rehabilitation measures. Rehabilitation centres may make a man fitter than he has ever been before in his life, and yet may fail to make him fit for his work, because he has not been retrained for that particular type of activity. A professional athlete may wish to distemper the ceiling of his sitting-room, and will find that the effort exhausts him and produces severe aching pains in his arm. Yet a professional decorator of the most indifferent physique can whitewash ceilings all day long without noticing any fatigue.

All exercises should therefore be as nearly as possible an imitation of some natural activity in order to avoid fatigue, to retain the patient's interest, and in the final stages to make him fit for his own *particular occupation*.

Special Exercises

Mobilizing Exercises

The purpose of such exercises is to overcome resistance to movements when it is due either to the presence of fibrous adhesions in or around the joints, or to tightness of the muscles resulting from contracture or spasm.

In the former case the physiotherapist assists the patient to carry out actively those movements which are limited. Such assistance and supervision is necessary because the patient will tend to develop trick movements so as to avoid the necessity to attempt those movements which are restricted. For example, abduction of the arm by

muscles generally when they have been weakened by recumbency, disease or paralysis.

2. To assist in restoring the circulation in a limb following disease or trauma and so promoting the absorption of exudates that might otherwise become organized into fibrous tissue (see p. 79).

3. To assist in restoring mobility. The stiffness that may result from the necessary immobilization following trauma, or during the course of a disease, can be most effectively and safely overcome by active exercises designed to encourage those movements that have become limited. They are necessary because the patient when using the limb will tend to avoid those movements which are limited and so, without special supervision, they may never be regained.

4. To correct defects of posture. The majority of special exercises given for this purpose entirely fail to achieve their object. The cause of failure lies in a misconception of the rationale of such exercises. This problem was considered in Chapter 1. It should be appreciated [illegible]

cept, it is fraught with practical difficulties, as any games instructor will fully appreciate. Yet, though it is generally recognized that to endeavour to correct a 'slice' at golf may take a lifetime of patient and unrewarding endeavour, it is expected that the physiotherapist will correct 'flat feet' or a 'round back' by a few exercises given once or twice a week.

It is unfortunately the fact that a great deal of time, effort and money is wasted in treating postural defects by special exercises which are faulty in conception and futile in practice.

When prescribing any course of exercises the following considerations should be borne in mind:

1. Muscles are more often used to prevent a movement than to effect one. For example, when elevating one's arm a few muscles of the shoulder region are employed to effect the movement. At the same time some 400 other muscles in the body will alter their tone to prevent unwanted movements elsewhere which would otherwise result from the change of balance.

2. Muscles usually function upside down. That is to say, in the reverse direction from that suggested by their name. For example, although the gluteus medius can act as an abductor of the hip, its essential function is to prevent the pelvis from tilting down on the

opposite side when standing on one leg. In order to do this it uses its 'insertion' into the great trochanter as the fixed point, which is thus functionally its origin.

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4. To correct defects of posture. The majority of special exercises given for this purpose entirely fail to achieve their object. The cause of failure lies in a misconception of the rationale of such exercises. This problem was considered in Chapter 1. It should be appreciated that, though the general idea of correcting postural defects and faulty use of the locomotor system by special training is admirable in concept, it is fraught [illegible] instructor will fully apprecia[illegible] to endeavour to corr[illegible]ent and unrewarding endeavour, it is expected that the physiotherapist will correct 'flat feet' or a 'round back' by a few exercises given once or twice a week.

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rotation of the scapula when abduction at the shoulder joint itself is limited. Such treatment is more effective when the parts are warm, while preliminary light massage will help to allay tension of both physical and psychological origin. The instructions for treatment should therefore be: assisted active mobilizing exercises with preliminary heat (specifying type) and light massage.

If the restriction of movements results from contracture or spasm in muscles the treatment is quite different. It is impossible to stretch a muscle for it always reacts to a stretching force by reflex contraction. The way to make a muscle elongate is to induce reflex relaxation by active contraction in the opposing group. Thus, for example, in order to cause relaxation of the calf muscles the patient is told to try to dorsiflex the foot against the resistance of one's hand placed on top of the foot, which gradually permits the movement to take place. It will be possible to dorsiflex the foot much farther in this way than if one had attempted to force it upwards.

For tightness and spasm in muscles one therefore advises resisted, relaxation exercises.

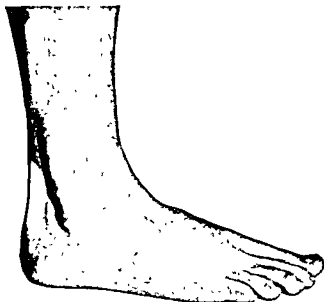
Corrective Exercises for Postural Defects

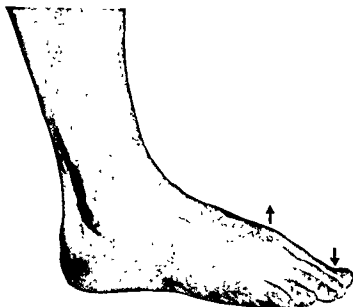
These are not really exercises at all, but comprise methods of training the individual to develop correct habits of posture. Their rationale was discussed in Chapter 1.

The Spine

For the more severe types of spinal defect and especially those such as scoliosis, where some paralytic element may be present, remedial exercises require very careful and expert planning and need not be considered here.

In cases of low back strain and lesions of intervertebral disc, however, it is often helpful if the patient can be shown exercises that he can do at home. Such exercises should be performed in recumbency in order to avoid strain on the joints. The only movements permitted should be those of extension since they are the only ones that are safe, moreover it is the extensor group of muscles that are the chief protectors of the spine. The movements should be a rhythmical alternation of contraction and relaxation in order to produce the maximum pumping effect on the local circulation. Finally, the muscles should be used both ways, that is to say, to elevate the shoulders and the legs alternately. Thus the patient is told to lie





EXERCISE FOR TOE FUNCTION

See p 101.

PLATE VII



I



II



III

FOOT EXERCISES

I Standing with foot relaxed II Screw up long arch, first by inverting foot as a whole, then III, depress first metatarsal head to complete the action This should be accomplished by the contraction of peroneus longus Instructor's finger may assist at first as shown

prone, elevate the legs, hold it, lower them and then relax, actively and consciously; then lift up the head and shoulders, hold it, lower them and again relax. Thus the rhythmical contractions and relaxations not only strengthen the muscles but promote an accelerated circulation.

The Foot

Most special exercises for foot defects are ill conceived and might be positively harmful if they were not, fortunately, ineffective. Among the worst offenders are: walking on tiptoe, walking with the feet twisted in, and picking up objects with the toes. The first is often prescribed in cases where a flat-footed appearance is compensatory to short calf muscles, when precisely the opposite position should be encouraged. The second can only do harm if the defective posture is in fact due to inversion of the forefoot (see p. 56). Since we no longer live in trees the grasping action of the toes has no functional significance and does nothing to encourage correct toe action. There are just two exercises that can only be beneficial to any foot of child or adult:

1. Screwing up the long arch.

It was explained in Chapter v that the long arch of the foot is built up into its fully arched posture of activity by a movement of inversion of the foot as a whole, combined with an equal degree of eversion of the forefoot in order to keep it plantar grade. Since this action is carried out by the controlling muscles of the foot, it can be practised as an exercise. To begin with it can be done more easily in two stages. First, the foot as a whole is inverted, then while maintaining this posture, the forefoot is everted by actively pressing the ball of the foot on to the ground. This action is in fact carried out by contraction of peroneus longus (see Plate VII). Once these two actions have been learned separately they can be carried out simultaneously. They can then be practised at any odd times, such as when standing in bus queues, for like most exercises they are unlikely to do much good unless practised regularly as a habit.

2. To promote good toe function.

The only essential function of the toes is to be able to press firmly on the ground with their pads so as to relieve some of the pressure on the metatarsal heads. This demands a combined contraction of the long flexors together with the lumbricals and interossei.

PLATE VII



I



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[illegible] relaxed. II. Screw up long arch, first by

as shown

MANIPULATIVE TREATMENT

Manipulative measures are employed for three distinct purposes: the replacement of structures that have become displaced, to break down fibrous adhesions, or to stretch contracted tissues.

Apart from the reduction of fractures and dislocations, manipulation has a limited sphere of usefulness in the first of these categories, despite the claims of the lay practitioners. Its main uses in this field are: for the reduction of displaced semilunar cartilages in the knee, for loose bodies in joints that are causing mechanical locking, for a displaced cartilage in the tempero-mandibular joint, for sacro-iliac subluxations, and occasionally for displaced intervertebral discs.

There is one other condition that merits special mention – the nipped synovial fringe. The synovial fringes that fill up the space around the periphery of most joints may occasionally get caught between the joint surfaces, causing sudden acute pain. This occurs most frequently in the joints of the fingers and toes, in the wrist, and the radio-humeral compartment of the elbow joint.

Once a fringe has been nipped, owing to subsequent swelling it becomes progressively more liable to be nipped again. In the case of finger and toe joints the patient can be instructed how to relieve it himself. The answer is to apply a distraction force, i.e. try to pull off the finger or toe and maintain the pull for about half a minute. The vacuum created in the joint causes a bubble of gas to form and also perhaps a little extra fluid. When the traction is released and the joint surfaces come together the fringe is pushed out of the way. This trick must be practised immediately or the fringe will have become too swollen to be easily released.

In the great majority of cases manipulation is used to break down fibrous adhesions that are interfering with the free movement of a joint. Such fibrous tissue has been formed by the organization of extravasated blood or tissue fluids. The fibrous tissue thus formed is at first vascular, but gradually matures into white fibrous tissue which is almost avascular. When first formed the fibrous adhesions between adjacent tissues are likely to be short and broad. Subsequent movements of the parts will tend to stretch them out into long thin bands. It is only when this stage has been reached that they are amenable to treatment by manipulation.

If manipulation is carried out too soon when the adhesions are short and broad, they will be likely to be torn out by their roots, causing pain, considerable reaction and bleeding. On the other

To encourage this action one should endeavour to force up the metatarsal heads by pressing firmly on the ground with the pads of the toes. The toes must not be allowed to curl under, as in the grasping action, for no effective lifting action can then be achieved.

It is helpful to try first with the hands. Place them flat on a table palms down. Then press on the table with the heel of the palm and the pads of the fingers so as to force the knuckles upwards off the table. Having got the feel of this action the patient can then try to imitate it with the foot, so that while the heel and the pads of the toes remain on the ground, the downward thrust exerted by the latter forces up the metatarsal heads (Plate VI). It will be found easier to do this exercise if the toes overlap the edge of a book, or a board ½ inch thick cut as shown in Fig. 13.

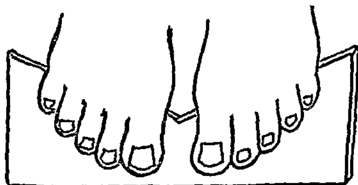


FIG. 13

USE OF BOARD FOR TOE EXERCISES

It is advisable and beneficial to be able to do this exercise oneself before trying to teach it to a patient!

Again, this exercise must be practised as a habit if any real benefit is to be derived from it. The best way to ensure this is to provide the patient with a board cut out as shown, which they fix to the floor under the basin where they wash, shave or clean their teeth. They can then develop the habit of doing these exercises regularly without bother and without taking up extra time. It can then also become a family habit, which can only do good, even when their feet are normal.

hand, if a long thin band of fibrous tissue is snapped across the middle there will be no pain or subsequent reaction since it has no nerve supply, and no bleeding since it is practically avascular.

The rules governing manipulation in such cases are therefore:

1. That the new fibrous tissue must have had time to mature – at least 2 and preferably 3 months from the time it is likely to have been first organized.

2. It should have been stretched as far as possible by active exercises before manipulation is undertaken.

3. It should be broken by a sharp jerk rather than by a slow stretching effort. The principle is the same as that used in breaking a length of string with the ends wound round one's fingers. A sharp jerk breaks the string and does not hurt, a slow pull will cause the string to cut into one's fingers but won't break it. So with manipulation – a sudden movement breaks the adhesion across, but a slow pull drags it out by the roots, which are likely to be in sensitive tissues.

4. In order to be effective there must therefore be no resistance by guarding muscles. This means either catching the patient off guard – a trick used by 'bone-setters' – or giving an anaesthetic. Intravenous thiopentone is ideal for the purpose, since it is short acting but gives good muscle relaxation.

5. Active use of a limb will often stretch out those adhesions which are affected by the ordinary range of active movements until they no longer restrict movements or cause symptoms. Adhesions which are only put on the stretch by the accessory movements of joints (see Gray's Anatomy!) are much more likely to persist, giving rise to occasional sharp twinges on activity, in a joint whose range of active movements may be otherwise normal. These are the cases that make the fortunes of the unqualified practitioners, for the patient who complains of pain in a joint that appears to be normal is likely to be labelled as neurotic – and is then cured by a bone-setter.

It is therefore essential to pay particular attention to the accessory movements, both on examination and when performing a manipulation.

6. It is those joints with a reasonably free range of movements, *not* the really stiff ones, that respond best to manipulation. The reason for this paradox is that severe restriction of movements is likely to be due to tough broad adhesions that could only be pulled out by

their roots, and this would cause severe pain and reaction, which might well result in even greater stiffness.

7. Manipulation should not be performed if any inflammatory reaction is present. This is indicated by muscle spasm and the fact that pain is produced by any movements of the joint and not just at the extremes of movement. Further, there should be no pain in the joint while at rest.

The stretching of contracted tissues, such as the capsules of joints, by manipulation has a definite but very limited sphere of usefulness. It is sometimes useful in the case of an apprehensive patient who will not co-operate effectively with active assisted exercises. A good stretch under an anaesthetic may then save much time and trouble, but it requires considerable judgment otherwise a reflex reaction may be set up which delays rather than accelerates recovery. In certain conditions such as osteoarthritis of the hip one knows by experience that a manipulation will often result in relief of pain lasting many months, yet when doing it one is not aware of having broken down any adhesions, and it may be that the benefit is due to simple stretching of a contracted joint capsule.

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CHAPTER XII

SPLINTS AND APPLIANCES, PLASTER CASTS

In present-day orthopaedics, splints play a very much smaller part than formerly. Since the motif of orthopaedics changed from the correction of deformities to the maintenance of function the role of splints has also changed. In the past splints were used in an endeavour to correct some deformity no matter what physical and psychological trauma they caused in the process. Now they are used to assist the disabled to retain, or to regain, mobility.

Since the primary function of the locomotor apparatus is to enable us to move and to orientate ourselves in relation to our environment, the only function of a splint is to assist or to help to restore our power to do so.

Splints can therefore be of service in one of three ways: to prevent deformity occurring during the course of some illness; to assist the healing processes by providing rest and protection to parts damaged by injury or disease; or to provide external support during activity when for some reason the muscles are unable to carry out their supporting functions adequately.

Most orthopaedic appliances should be prescribed and checked by the orthopaedic specialist and need not therefore be considered here. There are, however, a number of simple means of assisting recovery of function which should be understood by all those who may have to deal with disabilities of the locomotor system.

Bandages

A properly applied bandage is one of the most useful and comforting splints for a limb that requires rest and protection but does not need complete immobilization. The most important rule is that a bandage should always be applied obliquely to the transverse axis of the limb so as to produce a herring-bone effect.

Two methods of bandaging merit special mention.

(i) *For the Elbow*

As stated earlier, the elbow is more demanding of rest and protection following an injury than any other joint. The following method

of bandaging over a layer of cotton wool provides a most efficient and safe splint.

After a few turns above the elbow the bandage is carried to the wrist and then carried round the wrist under the first turn and then

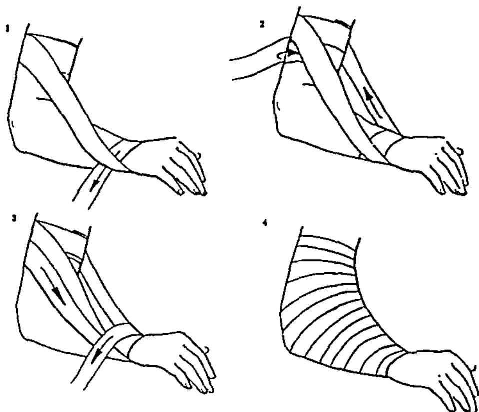


Fig. 14

ELBOW BANDAGE

The bandage is first looped round the upper arm, then carried to the wrist, forming a 'bowstring'. It is then passed round the wrist under the bowstring and then back to the upper arm. It then passes round the arm under the two bowstrings now formed and then back to the [illegible]

back to the upper arm. Thus two bowstrings are formed and held by passing the bandage round under them (Fig. 14). Finally the whole of the arm and forearm is encircled with bandage including the 'bowstrings'.

(ii) *For the Knee*

A knee bandage is usually applied with the object of providing a compressing effect upon any effusion that may be present. It is then carried up to the lower part of the thigh to exert compression on the supra-patellar pouch.

Bandaging can also be usefully employed to give protection to the joint following injuries such as damage to a semilunar cartilage. Since the joint line lies below the 'bend' of the knee, this type of bandaging should be *much lower, extending from the patella to the mid-calf* with most of the turns a hand's breadth below the patella. It need not be taken above the patella, but it requires two full-length crepe bandages to protect the joint adequately. The writer only discovered the above secrets after damaging his own medial cartilage!

Adhesive Strapping

It is over 100 years since a bone-setter annunciated the classic treatment for a sprain: rub, strap and use.

In the majority of cases strapping applied for a sprained ligament can do little or nothing to protect it from subsequent strain, yet it *undoubtedly does give considerable comfort and relief, which must* be mainly psychological in origin.

For example, strapping applied down the inner side of the knee for a sprained medial ligament cannot possibly have any effect in preventing subsequent stretching of the ligament, but the owner of the ligament will be in no doubt that he can then walk with greater comfort and with a feeling of security.

It is important, however, that such strapping should not impede the circulation of the limb, and should not limit any movements except those that might put the damaged ligament on the stretch.

Strapping of the ankle for a sprained lateral ligament affords a good example (Plate IV). *The strapping should start on the lateral* side of the dorsum of the foot and pass inwards, then under the sole and up the outer side of the leg, holding the foot in slight eversion. Two more layers are then similarly applied, with a circular turn to hold their upper ends in position. This will prevent movements of inversion but will not impede any other movements – nor the circulation of the limb.

Plaster of Paris

No orthopaedic surgeon could dare to contemplate life without

plaster of Paris, but it should also be the handmaid of everyone who has to deal with disabilities of the locomotor system.

For First Aid

No doctor can be expected to carry around an assorted collection of splints. Nor would they ever fit the individual case if he did so. Fortunately all he could ever need is a box of 6-inch plaster bandages, *though it is surprising how few doctors appreciate their value.*

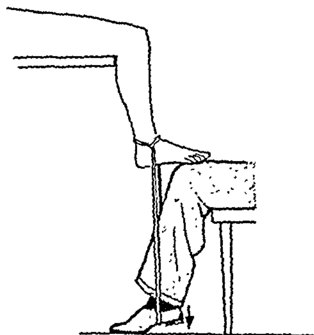


FIG. 15

METHOD OF REDUCING FRACTURES OF THE SHAFT OF THE TIBIA

For the initial treatment of any limb injury or acute inflammatory condition the technique is as follows:

The bandage is unrolled and folded backwards and forwards to make a slab of the desired length. Its width should equal half the circumference of the limb. If necessary the bandage is cut through to the desired width before unrolling, after commandeering the family carving knife. The slab is then soaked in a basin of warm water and applied to the limb, being held in place by a wet cotton bandage. As soon as the plaster has set, the bandage is cut down the length of the limb on the opposite side from the plaster slab.

Such plaster slabs are applied to the outer side of the arm from the shoulder to the elbow; to the dorsum of the forearm and wrist; flexor or extensor aspects of fingers, and the back of the leg or foot.

For the treatment of the more severe types of injuries it is usually considered that an accident unit equipped with all the most complicated and expensive gadgets is essential. Since many injuries must perforce be dealt with by those who are less luxuriously equipped, the following hints may be helpful:

1. For the reduction and fixation of fractures of the tibia some form of traction apparatus is usually considered to be desirable. The following method is simpler and can be undertaken in the farm kitchen: The leg is allowed to hang over the edge of the bed or table on which the patient is lying. A clove hitch is placed round the ankle using a bandage. The two ends are then tied together to form a loop (Fig. 15). The operator sits on a chair or stool facing the leg, with the loop of bandage under the heel of his foot, and the ball of the patient's foot supported on his knee. The loop of the bandage is adjusted to the correct length so that as he presses his heel towards the ground traction is exerted on the leg. Very powerful traction can be produced in this way. Both his hands are free to manipulate the fracture whilst traction is maintained. When the fracture is in satisfactory alignment a back slab of plaster of Paris is applied and bandaged on with a wet cotton bandage. As soon as it has set, traction is released and the clove hitch bandage is cut.

2. Application of a plaster jacket.

If the patient can sit or stand this presents no difficulties. In the case of a patient who must remain recumbent or who is anaesthetized the following procedure can be used:

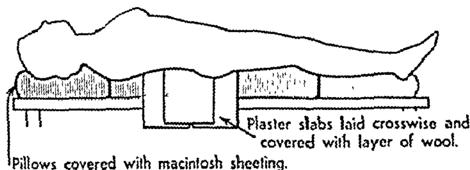
A row of pillows is placed transversely down the length of a canvas stretcher trolley and covered with rubber or macintosh sheeting. Three plaster slabs of 6-8 thicknesses are prepared from 8-inch plaster bandages. They should be long enough to encircle the patient's body and allow about a 12-inch overlap.

They are soaked and laid across the stretcher as shown, the first two side by side, the third being laid in the middle to overlap the other two (Fig. 16). They are covered with a layer of plaster wool and the patient is then placed supine on top. The wool is first folded round the patient, then the central slab, followed by the other two, the slabs being drawn comfortably tight before overlapping in front.

The jacket is now complete and will be found to fit perfectly as the pillows have moulded it accurately in to the patient's back.

3. Plaster hip spica

After proceeding as for a plaster jacket, the pillows under the patient's legs are removed, an assistant holding the affected leg in the desired position. A plaster cast is now applied to the leg and joined to the plaster jacket with plaster slabs.



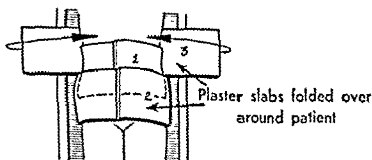


FIG. 16

APPLICATION OF A PLASTER JACKET

APPLIANCES

The Neck

It is frequently desirable to provide rest and support for disorders affecting the cervical spine. Although bed rest is ideal for the local lesion, it is irksome and demoralizing for the patient. Most forms of cervical support, though sometimes necessary, are more than irksome, and the patient usually spends his time easing his head away from the support! Such supports therefore rarely in fact provide support though they do restrict movements. For the less severe and serious

Such plaster slabs are applied to the outer side of the arm from the shoulder to the elbow; to the dorsum of the forearm and wrist; flexor or extensor aspects of fingers, and the back of the leg or foot.

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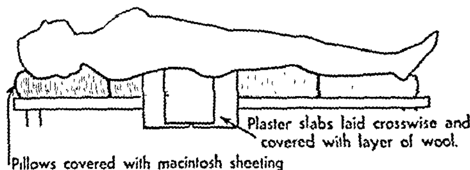
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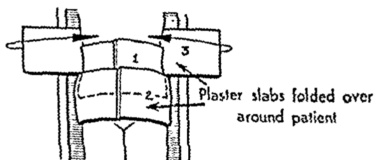


Fig. 16

APPLICATION OF A PLASTER JACKET

Appliances

The Neck

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cases a good compromise is a cervical collar made from sponge rubber sheeting (Fig. 4). Though not strictly immobilizing, it does provide support and it is comfortable. Moreover, it can be made 'on the spot'.

The Spine

The supply and fitting of most spinal appliances are the responsibility of orthopaedic units. In the treatment of the common mechanical disorders of the lumbar spine surgical corsets are widely used in medical practice. They consist essentially of a back splint which can be in the form of a rigid frame made of steel, or strips of spring steel in the fabric of the corset. These are held against the spine by one or two fabric bands which pass round the body and are tightened by buckles in front. The rest of the support consists of a fabric belt or corset to carry the splint and retain it in place. When checking such supports the essential point is to make sure that the posterior splint accurately fits the spine in the erect posture.

The Hip

Support for a weak or painful hip can be provided by a walking caliper. These are expensive, difficult to fit and most unpopular with the patients. Many are ordered but few are worn, except in cases of severe paralysis.

A lesser measure which is sometimes helpful for the arthritic hip is a hip corset. This consists of a short lumbar corset of the usual type with an extension down the thigh. A cross band passes from the region of the great trochanter to the pelvis on the opposite side, where it is tightened with a buckle as firmly as is comfortable.

The Knee

For the painful arthritic knee a knee corset may be helpful. This again follows the pattern of a spinal corset, being made of fabric reinforced with thin spring steel strips and lacing up either down the front or on one side.

The Foot

Wedges. An inside wedge to the heel of the shoe is often prescribed in cases of defective foot posture or knock knees. Such wedges should be fitted to the top, not the bottom of the heel (Fig. 17). The shoe must also fit accurately around the heel region,

otherwise the foot will not be tilted by the shoe, but will simply slide down the cross slope into an even worse position of eversion (Fig. 18). Shoes must always be checked after a period of wear in order to assess whether the amount of wedging is correct.

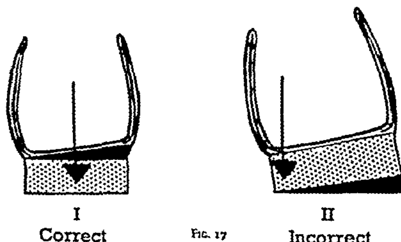


FIG. 17
HEEL WEDGES

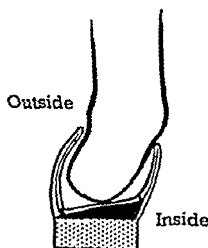


FIG. 18
INEFFECTIVE HEEL WEDGES

Inside wedges to the sole of the shoe are practically never indicated.

'Float out' heel. This is a small buttress fitted to the outer side of the heel. It is useful in preventing repeated sprains in those who have weak ankles (Fig. 19).

Long-arch and 'valgus' supports. These should be moulded so a
fill up the space between the long arch and the shank of the sl
Cork is the most suitable material, being light, cool and por
Metal supports are only required for very heavy individuals or w
the shank of the shoe is not strong enough to support the wei

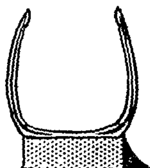


FIG 19
'FLOAT OUT' HEEL

Long-arch supports may be built into the shoe, when they are usua
referred to as valgus lifts, or they may be in the form of a loose ins
which can be transferred from one shoe to another.

Such supports are useful for three purposes:

1. To assist in the correction of postural defects

Before the postural centres can be induced to accept any ne
posture as a habit, they must get used to the feel of the new positic
Supports which hold the foot in a corrected position can therefore
useful provided that their use is supplemented by corrective postu
training, so that they can be discarded when the new habits of postu
have been firmly implanted.

2. In convalescence

3. As a permanent measure

If the condition of the feet and the amount of work expected of them is such that foot strain is inevitable, supports may have to be provided as a permanent measure. This is, however, a serious step to take, for once they have been provided it is unlikely that the individual will ever be able to do without them.

Anterior or metatarsal supports. These consist of a pad, usually made of compressed felt, which is moulded to fit immediately behind the metatarsal heads.

They are sometimes fitted under the metatarsal heads with the mistaken idea of restoring the 'transverse arch' which is in any case non-existent in the normal standing position.

Their function is the purely palliative one of providing for the distribution of weight over a wider area in cases where the toes are not taking their fair share.